CENTRAL VALLEY REGIONAL
WATER QUALITY CONTROL BOARD

Amendments to The Water Quality Control Plan for the Sacramento River and San Joaquin River Basins For The Control of Mercury in Cache Creek, Bear Creek, Sulphur Creek, and Harley Gulch

Staff Report

Public Review Draft Report

June 2005

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

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AMENDMENTS TO THE WATER QUALITY CONTROL PLAN FOR THE SACRAMENTO RIVER AND SAN JOAQUIN RIVER BASINS FOR THE CONTROL OF MERCURY IN CACHE CREEK, BEAR CREEK, SULPHUR CREEK, AND HARLEY GULCH (COLUSA, LAKE AND YOLO COUNTIES)

Staff Report

EXECUTIVE SUMMARY

This Central Valley Regional Water Quality Control Board staff report describes a proposal to amend the Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins to address the regulation of mercury in Cache, Bear, and Sulphur Creeks and Harley Gulch (Lake, Colusa, and Yolo Counties). Regional Water Board staff will circulate this staff report and the enclosed draft Basin Plan amendments for public review and comment prior to Regional Water Board consideration. Appendix F provides the recommended format for comment submittal.

Major components of the proposed amendments are:

- Addition of a beneficial use designation of commercial and/or sport fishing (COMM) for Cache and Bear Creeks;
- Numeric objectives for methylmercury in fish tissue that are site-specific to Cache Creek, Bear Creek, and Harley Gulch;
- An implementation plan for controlling methylmercury and mercury loads; and
- A surveillance and monitoring program.

Cache, Bear, and Sulphur Creeks and Harley Gulch are on the Clean Water Act 303(d) List of Impaired Water Bodies because of elevated levels of mercury in water and sediment. In addition, levels of mercury in fish in Cache and Bear Creeks exceed the USEPA recommended criterion for the protection of human health. The goal of the proposed Basin Plan amendments is to lower mercury levels in these water bodies so that the beneficial uses of fishing and wildlife habitat are attained.

Proposed Modifications to Basin Plan Chapter II (Existing and Potential Beneficial Uses)

Staff proposes addition of the commercial and sport fishing (COMM) beneficial use for Cache and Bear Creeks. The sport fishery in Cache and Bear Creeks is moderately used. There is no commercial fishing currently or intended on either creek.

Proposed Modifications to Basin Plan Chapter III (Water Quality Objectives)

Staff proposes site-specific, numeric objectives of methylmercury in fish tissue for Cache and Bear Creeks and Harley Gulch. No objective is proposed for Sulphur Creek because it does not support fish. Methylmercury is the most toxic form of mercury and accumulates in successive levels of the food chain. It is a neurotoxicant that adversely affects reproductive and immune systems in humans and wildlife that consume fish. Nearly all methylmercury is acquired through consumption of mercury contaminated fish and shellfish. Staff considered four alternatives for the methylmercury numeric objectives:

1. **Objective Alternative 1 - No Action**. This alternative is for continued application of the Basin Plan's narrative objective for toxicity. This alternative does not set a numeric limit for the concentration of methylmercury in fish tissue.
2. **Objective Alternative 2.** These numeric objectives are based on protection of sensitive wildlife species and human health. For Cache and Bear Creeks, they are 0.23 mg methylmercury/kg fish, wet weight in trophic level 4 fish (piscivorous species including bass and catfish) and 0.12 mg/kg in trophic level 3 fish (bluegill, sunfish, and sucker). For Harley Gulch, the objective is 0.05 mg methylmercury/kg, wet weight in small, resident fish (such as roach and hardhead less than 4 inches in length).
3. **Objective Alternative 3.** Objectives are based on the USEPA's recommended methylmercury criterion for the protection of human health, assuming that people eat mainly trophic level 4 fish. For Cache and Bear Creeks, objectives are 0.3 mg/kg, wet weight in trophic level 4 fish and 0.15 mg/kg in trophic level 3 fish. For Harley Gulch, the objective is 0.05 mg methylmercury/kg, wet weight in small, resident fish.
4. **Objective Alternative 4.** Objectives are also based on the USEPA's recommended methylmercury criterion for the protection of human health, assuming that people eat equal proportions of trophic level 3 and 4 fish. For Cache and Bear Creeks, objectives are 0.4 and 0.2 mg/kg, wet weight in trophic level 4 and 3 fish, respectively. For Harley Gulch, the objective is 0.05 mg methylmercury/kg, wet weight in small, resident fish.

Staff recommends adoption of Objective Alternative 2. These objectives will protect local threatened and endangered species, including bald eagles. Attainment of these objectives would allow humans to safely consume 22-40 g/day (3-5 meals/month) of Cache and Bear Creek fish, depending upon size and species of local fish and intake of commercial fish. This range is slightly more than the USEPA default consumption rate (17.5 g/day) used in Alternatives 3 and 4.

Proposed Modifications to Basin Plan Chapter IV (Implementation)

Staff proposes addition of a strategy to reduce mercury and methylmercury loads in Cache, Bear, and Sulphur Creeks and Harley Gulch. The strategy includes load allocations and aqueous methylmercury implementation goals linked to the fish tissue objectives. The source information is summarized in the TMDL reports appended to this report.

Cache Creek

In Cache Creek, the watershed above Rumsey was the major source of methylmercury. The highest concentrations and production rates were observed below the mercury mines in Harley Gulch, Sulphur Creek, and Bear Creek and in the canyon above Rumsey. Lower aqueous methylmercury concentrations were measured in the North Fork and Cache Creek below the Clear Lake dam, which have lower inorganic mercury concentrations in sediment.

Sources of total mercury in Cache Creek largely parallel the sources of methylmercury. Most mercury derives from the watershed upstream of Rumsey. On a 5-year average, mercury loads from the mine-related tributaries (Bear Creek, Harley Gulch, and Davis Creek), North Fork Cache Creek and Clear Lake contributed about 15 percent of the mercury loads measured in Cache Creek at Rumsey. In years with

high degrees of runoff or extreme erosional events, inputs from the inactive mines would be much greater. The majority of the inorganic mercury loads were from unnamed sources, which include smaller, unmeasured tributaries and mercury in the Cache Creek bed and banks. Clean sediment entering the watershed below Rumsey diluted sediment mercury concentrations.

Bear Creek

The Bear Creek watershed upstream of all mine inputs contributes minimally to the loads of methylmercury and total mercury in Bear Creek. Sulphur Creek contributes about half of each of the methylmercury and total mercury loads in Bear Creek. The remainder of the Bear Creek methylmercury likely comes from production within the channel and seepage of underground springs. The rest of the mercury load in Bear Creek likely derives from the remobilization of mine waste deposited in the floodplain.

Harley Gulch

Much of the methylmercury in Harley Gulch is likely produced in a wetland area in the West Branch Harley Gulch, downstream of the inactive mercury mines. Over ninety percent the total mercury load in Harley Gulch is estimated to come from the mine-impacted West Branch. Total mercury loads from the mines may be underestimated due to a lack of data collected during heavy rainfall events. An alluvial fan, possibly containing mine waste, at the Harley Gulch confluence with Cache Creek may contribute to the unnamed source of mercury in the Cache Creek canyon.

Sulphur Creek

Inactive mines in the upper Sulphur Creek watershed contribute an estimated 30% of the mercury load in the creek. The upper watershed also provides about 10% of the mercury loads, coming from mercury in stream sediment, erosion of background soil, and unidentified geothermal springs. Mercury loads in lower Sulphur Creek account for about 60% of the total mercury loads. Sources in this area include geothermal springs, mercury in stream sediments, and erosion from mines. Geothermal springs and production in the main stem contribute methylmercury as well as total mercury.

Implementation Alternatives

Staff considered three implementation alternatives to reduce mercury and methylmercury loads in the four water bodies and achieve the fish tissue objectives. All of the implementation alternatives will require public outreach regarding the levels of safe fish consumption and monitoring to assess progress toward the objectives. Production of methylmercury is positively correlated with level of mercury in surficial sediment. Reducing total mercury loads will reduce concentrations of mercury in sediment and is expected to reduce subsequent methylmercury production.

Implementation Alternative 1. **No Action.** No control actions would be required. This alternative relies completely on natural erosion and transport of mercury containing sediment out of the system. Passive dilution of mercury in streambed sediments by cleaner, incoming sediment would occur after erosion from mine sites has ceased.

Implementation Alternative 2. Alternative 2 proposes a combination of projects in the Cache Creek watershed to reduce the erosion and transport of mercury and generation of methylmercury. Actions to reduce mercury loads include:

- Remediation at inactive mines including the adjacent stream banks which contain mercury,

- Control of erosion in mercury-enriched areas from activities such as including grazing and road maintenance,
- Conduct feasibility studies and possible remediation at the Harley Gulch sediment delta,
- Control of mercury and methylmercury sources in the lower watershed, and
- Regional Board and landowner coordination to identify sites and projects to remediate/remove floodplain sediments containing mercury and implementation of feasible projects (particularly Cache Creek canyon and Bear Creek).

Actions to reduce methylmercury include additional studies of sources and possible control in Bear Creek and Anderson Marsh; and prohibition of increases in methylmercury inputs from any new impoundments, wetlands restoration projects, or geothermal spring development.

Implementation Alternative 3. This Alternative includes all of the proposed actions in Alternative 2 and additional projects to further reduce mercury loads, including:

- Remediation of mine wastes not immediately adjacent to mines,
- Additional remediation or removal of sediments with mercury in Cache Creek Canyon and Bear and Sulphur Creeks,
- Selective remediation or removal of sediments containing mercury in Cache Creek downstream of Rumsey,
- Treatment of geothermal springs,
- More stringent erosion control from grazing, road maintenance, firewood collection, and other anthropogenic activities, and
- Installation of small sediment basins downstream of mines, should mine cleanups prove financially or legally difficult.

Regional Water Board staff recommends Implementation Alternative 2 for adoption into the Basin Plan. Alternative 2 provides the best balance between cost and time to improvement in fish tissue concentrations. Alternative 2 is expected to reduce methylmercury loads in Cache Creek by 70 g/year and total mercury loads by possibly 60 kg/year when fully implemented. Cost for full implementation is estimated between $10 and $16 million. Because of the large amount of mercury present in the creek beds and banks, it will likely take multiple decades to see a significant change in mercury levels in fish and possibly several hundred years until objectives are attained.

Water quality objectives are not expected to be attained under Implementation Alternative 1. Implementation Alternative 3 will decrease loads of total mercury more quickly and at a greater cost than Alternative 3. Estimated costs for Alternative 3 are $50-120 million. As mercury repositories addressed in some projects in Alternative 3 are less concentrated than the mines (e.g., the stream bank downstream of Rumsey), costs are considerably higher than Alternative 2. Because of the quantity of mercury remaining in the Cache Creek canyon, however, fish tissue objectives may be attained only slightly sooner under Implementation Alternative 3.

Proposed Modifications to Basin Plan Chapter V *(*Surveillance and Monitoring)

Staff proposes a surveillance and monitoring program to ensure compliance with the objectives in Clear Lake. The program includes water, sediment, and fish tissue monitoring.

Environmental Analysis

To satisfy requirements of the California Environmental Quality Act, staff performed an environmental analysis of the potential impacts of the proposed Basin Plan amendments, including beneficial use addition, numeric water quality objectives, and implementation plan. The proposed amendments were found to have no significant adverse effects on the environment. Actions taken by entities to comply with the Basin Plan Amendment should be scrutinized for environmental impacts.

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LIST OF ACRONYMS

303(d) List	Clean Water Act 303(d) List of Impaired Waterbodies
ATSDR	U.S. Agency for Toxic Substances and Disease Registry
BAF	Bioaccumulation factor
Basin Plan	Water Quality Control Plan for the Sacramento River and San Joaquin River Basins
BCF	Bioconcentration factor
bwt	Body weight
CDFG	California Department of Fish and Game
CDHS	California Department of Health Services
CEQA	California Environmental Quality Act
Caltrans	California Department of Transportation
CTR	California Toxics Rule
CWA	Federal Clean Water Act
GLWQI	Great Lakes Water Quality Initiative Final Rule
Hg	Mercury
LOAEL	Lowest-observable adverse effect level
MRC	Mercury Study Report to Congress
MRL	ATSDR Minimal Risk Level
N	Population size
NAS	National Academy of Sciences
NEPA	National Environmental Policy Act
NOAEL	No-observable adverse effect level
NRC	National Research Council
OEHHA	Office of Environmental Health Hazard Assessment
Regional Water Board	Central Valley Regional Water Quality Control Board
RfD	Reference dose
SLC	State Lands Commission
State Water Board	State Water Resources Control Board
TL3	Trophic level 3
TL4	Trophic level 4
TMDL	Total Maximum Daily Load
TMDL Reports	Cache Creek, Bear Creek, and Harley Gulch TMDL for Mercury and Sulphur Creek TMDL for Mercury reports
UC Davis	University of California-Davis
USDA	US Department of Agriculture
USEPA	US Environmental Protection Agency
USFDA	US Food and Drug Administration
USFWS	US Fish and Wildlife Service
WHO	World Health Organization
mg/kg	Milligrams/kilogram, concentration in sediment or fish tissue
ng/L	Nanograms/liter, concentration in water

1 INTRODUCTION AND BACKGROUND

This Central Valley Regional Water Quality Control Board staff report (staff report) addresses proposed amendments to the Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins (CVRWQCB, 1998). The amendments address regulation of mercury in Cache Creek, Bear Creek, Sulphur Creek, and Harley Gulch in Colusa, Lake, and Yolo Counties.

California Water Code Section 13240 requires Regional Water Boards to prepare and adopt a Basin Plan to regulate water quality. The Regional Water Board Quality Control Board, Central Valley Region (Regional Water Board) initially adopted a Basin Plan in 1975. The Basin Plan was revised and updated in 1989 and 1994. The current edition (Fourth Edition 1998) incorporates several new amendments adopted since 1994. The Basin Plan satisfies Section 303 of the Clean Water Act, which requires states to adopt water quality standards to meet federal regulatory requirements. Basin Plans are adopted and amended by the Regional Water Board using a structured process involving full public participation and State environmental review. A Basin Plan includes a discussion of:

1. Beneficial uses to be protected,
2. Water quality objectives, and
3. An implementation plan needed for achieving water quality objectives.

The proposed Basin Plan amendments for control of mercury in Cache Creek, Bear Creek, Sulphur Creek, and Harley Gulch will be legally applicable once the amendments are adopted by the Regional Water Board and approved by the State Water Resources Control Board, State Office of Administrative Law, and the U.S. Environmental Protection Agency (USEPA). Implementation will begin after the Basin Plan amendments are legally applicable.

This report provides an analysis of alternatives and evaluation of potential environmental impacts in accordance with California Environmental Quality Act (CEQA) and State Water Resources Control Board (SWRCB) regulations. The Basin Plan amendment process is a certified regulatory program pursuant to CEQA. The Basin Plan amendment staff report therefore serves as a substitute document for Environmental Impact Report or Negative Declaration. The CEQA checklist and conclusions of the CEQA analysis are contained in this report.

The purpose of this staff report is to present the proposed Basin Plan amendments and to provide the rationale behind each part of the amendment. Section 1 provides an introduction and background for the Basin Plan amendment process. Section 2 presents the proposed changes to the Basin Plan and the language revisions proposed for adoption by the Regional Water Board. Section 3 describes beneficial uses and existing conditions of Cache Creek and its tributaries. Section 4 presents the evaluation of possible water quality objectives. Section 5 describes the several alternatives for implementation that staff considered. Section 6 details the monitoring and surveillance plan proposed for Cache Creek and its tributaries. Section 7 provides the California Environmental Quality Act (CEQA) documentation and checklist. Appendices A and B provide information and references for the mercury total maximum daily load (TMDL) reports for Cache, Bear, Sulphur Creeks, and Harley Gulch; the final TMDL reports formed the basis of many sections of the proposed Basin Plan amendments and this staff report.

1.1 Watershed Area to Be Considered

For the purposes of this report, Cache Creek, Bear Creek, Sulphur Creek, and Harley Gulch may be collectively referred to as the Cache Creek Watershed or Cache Creek and Tributaries (e.g., the Cache Creek Watershed TMDL, or Cache Creek and Tributaries Basin Plan amendments). Discussions of individual water bodies will be identified with the proper name of the water body. Other tributaries to Cache Creek (e.g., Davis Creek) that are on the Clean Water Act 303(d) list will be addressed in a separate TMDL report and Basin Plan amendment report.

This staff report and proposed Basin Plan amendments includes four 303(d) listed waters, including:

1) Cache Creek: 81-mile reach between Clear Lake and the Cache Creek Settling Basin,
2) Harley Gulch: eight miles from headwaters to Cache Creek,
3) Bear Creek: 39 miles from headwaters to Cache Creek, and
4) Sulphur Creek: 7 miles from headwaters to Bear Creek.

Cache Creek drains a 0.7 million-acre watershed in the Coast Range of California (Figure 1.1). Cache Creek drains to the Cache Creek Settling Basin, which discharges to the Yolo Bypass and flows into the Sacramento-San Joaquin Delta Estuary.

The upper Cache Creek basin (above the town of Rumsey) is naturally divided into three sub-basins: North Fork (Cache Creek), South Fork (Cache Creek), and Bear Creek. The three water bodies flow year round. Dams at Indian Valley and Clear Lake control flows in the North Fork and main stem creek, respectively. The lower Cache Creek basin (downstream of Rumsey) flows past farmland and several small communities including Guinda, Brooks, Capay, Esparto, and Yolo and the larger community of Woodland. Cache Creek flows into the Cache Creek Settling Basin, an engineered structure designed to decrease the movement of sediment into the Yolo Bypass.

Bear Creek flows from its headwaters to the confluence with Cache Creek, about midway through the Cache Creek Canyon. The Bear Creek watershed is sparsely populated. Much of the Bear Creek watershed, including Bear Valley, is rangeland. The lower portion of the watershed is rugged and lies within the USBLM Cache Creek management area. Inactive mercury mines in the Rathburn-Petray group discharge primarily to Bear Creek. No dams are present in the Bear Creek watershed.

Harley Gulch drains a 3,412-acre watershed in the upper Cache Creek basin. Harley Gulch is an ephemeral stream with flowing water between October and June. At other times it is a series of isolated pools. The inactive Turkey Run and Abbott mercury mines drain to the west branch Harley Gulch.

Sulphur Creek flows from its headwaters to Bear Creek. Sulphur Creek flows through part of the Sulphur Creek mining district. Inactive mines along the creek include the Elgin, Clyde, Empire, Manzanita, West End, Central, Cherry Hill, and Wide Awake mines.

The Cache Creek watershed lies within a region naturally enriched in mercury. Sources of mercury to include discharges from numerous inactive mines, erosion of stream beds and banks which contain mercury, natural and anthropogenic erosion of soils with naturally occurring mercury, natural and altered geothermal springs, and atmospheric deposition. All mercury mines in the basin are now inactive.

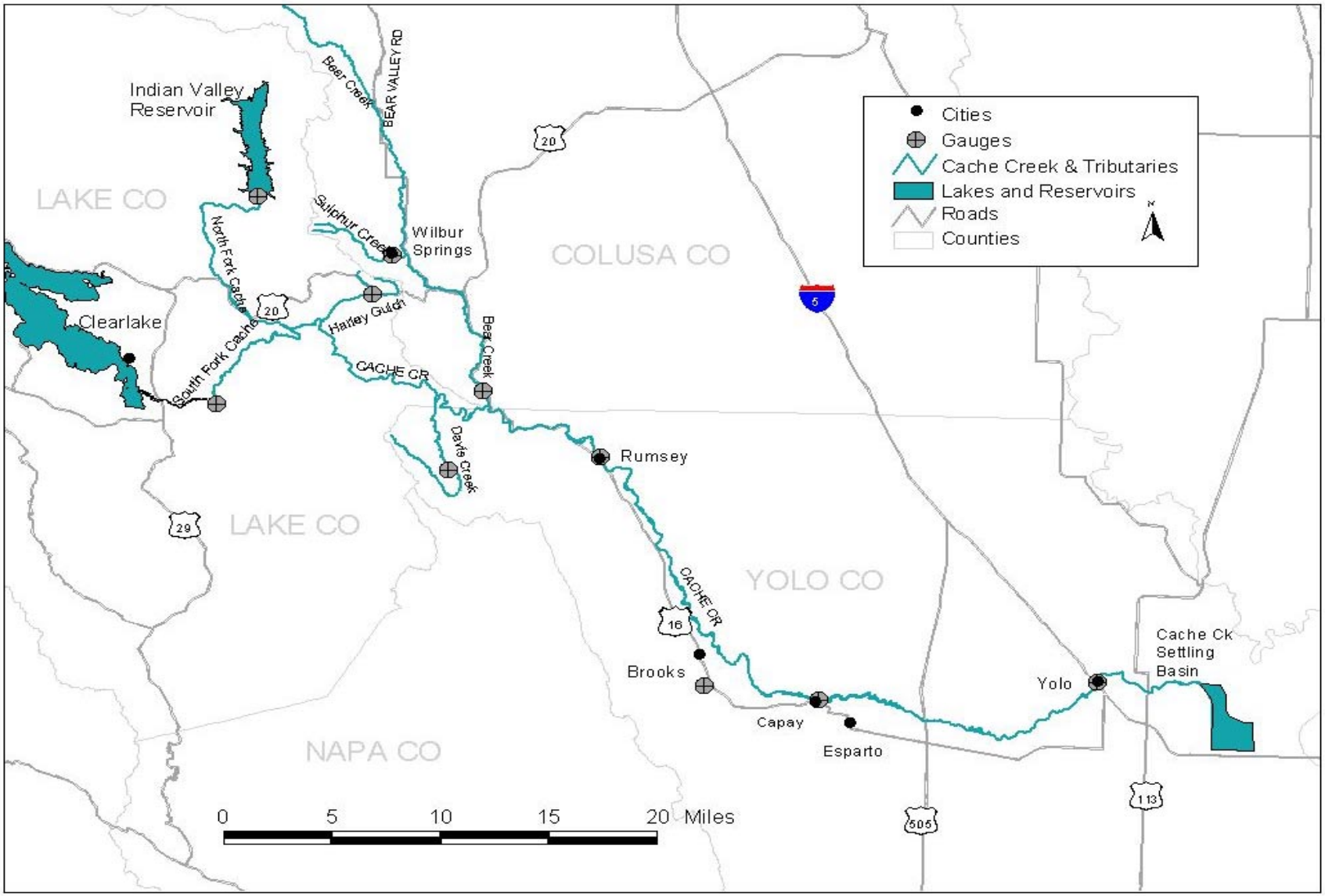

Figure 1. Cache Creek Watershed

1.2 Need for an Amendment to the Basin Plan

Section 303(d)(1)(A) of the Clean Water Act requires the California Regional Water Quality Control Boards to:

- Identify the Region's waters that do not comply with water quality standards applicable to such waters;
- Rank the impaired water bodies, taking into account factors including the severity of the pollution and the uses made of such waters; and
- Establish water quality management strategies (Total Maximum Daily Loads; TMDLs) for those pollutants causing the impairments to ensure that impaired waters attain their beneficial uses.

Beginning in 1988, the Regional Water Board identified Cache Creek and some of its tributaries as impaired due to mercury and recommended that they be placed on the 303(d) list of impaired water bodies. Fish in Cache Creek and Bear Creek have elevated fish tissue mercury levels. In addition, water column concentrations of mercury exceed the California Toxics Rule (CTR) water quality criterion in Cache Creek and its tributaries during storm events. Mercury in aquatic environments may be transformed by certain bacteria into methylmercury, a highly toxic and bioavailable form of the element.

The Regional Water Board will develop a water quality management strategy for each water body and pollutant in the Central Valley identified on California's 303(d) List. The management strategy for control of mercury in the Cache Creek Watershed is being conducted in several phases:

- Total Maximum Daily Load Development: involves the technical analysis of the sources of pollutant, the fate and transport of those pollutants, the numeric target(s), and the amount of pollutant reduction that is necessary to attain the target. The TMDL report for Cache Creek, Bear Creek, and Harley Gulch was released to the public for comment in November 2003 and submitted to USEPA in February 2004. The Sulphur Creek TMDL report was released to the public in August 2004. The TMDL reports formed the basis of many parts of the proposed Basin Plan amendments and this staff report. Comments received on the TMDL reports were also considered in the development of this staff report.
- Basin Planning: focuses on the development of a Basin Plan amendment and a Functionally Equivalent Document for Regional Water Board consideration. The Basin Plan amendment will include those policies and regulations that the Regional Water Board believes are necessary to attain water quality objectives. The Functionally Equivalent Document includes information and analyses required to comply with the California Environmental Quality Act.
- Implementation: focuses on the establishment of a framework that ensures that appropriate practices or technologies are implemented (§13241 and §13242 of the Porter-Cologne Water Quality Act), including those elements necessary to meet federal TMDL requirements (CWA Section 303(d)).

The narrative water quality objective for toxicity in the Basin Plan states, "*All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human,*

plant, animal, or aquatic life. This objective applies regardless of whether the toxicity is caused by a single substance or the interactive effect of multiple substances. Compliance with this objective will be determined by analyses of indicator organisms, species diversity, population density, growth anomalies, and biotoxicity tests of appropriate duration or other methods as specified by the Regional Water Board.

The Regional Water Board will also consider all material and relevant information submitted by the discharger and other interested parties and numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective.

The survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality factors shall not be less than that for the same water body in areas unaffected by the waste discharge, or, when necessary, for other control water that is consistent with the requirements for "experimental water" as described in Standard Methods for the Examination of Water and Wastewater, latest edition. As a minimum, compliance with this objective as stated in the previous sentence shall be evaluated with a 96-hour bioassay.

In addition, effluent limits based upon acute biotoxicity tests of effluents will be prescribed where appropriate; additional numerical receiving water quality objectives for specific toxicants will be established as sufficient data become available; and source control of toxic substances will be encouraged." (CVRWQCB, 1998).

At this time, the Basin Plan does not include numeric water quality objectives for methylmercury or an implementation plan to control methylmercury or total mercury in the Cache Creek Watershed. Therefore, Regional Water Board staff proposes that the Basin Plan be amended to include water quality objectives and methylmercury and total mercury reduction strategies for Cache Creek, Bear Creek, Sulphur Creek, and Harley Gulch.

2 PROPOSED AMENDMENTS TO THE BASIN PLAN

2.1 Summary of the Proposed Amendments

Proposed modifications to the Basin Plan include:

1. Addition of the commercial and sport fishing beneficial use (COMM) for Cache Creek and Bear Creek;
2. Site-specific numeric water quality objectives for methylmercury in Cache Creek, Bear Creek, and Harley Gulch; and
3. A water quality management strategy for methylmercury and total mercury in the Cache Creek Watershed.

The text on the following pages contains the proposed Basin Plan modifications. Existing Basin Plan language is in *italics* while text additions are indicated by underline and text deletions are indicated by ~~strikethrough~~.

No modifications are proposed for the following chapters of the Basin Plan:

- Chapter I (Introduction)
- Basin Plan Appendix

Please note: The proposed Basin Plan language reflects the alternatives for water quality objectives and implementation plan recommended by Regional Board staff. Should the Regional Board select different alternatives or modify those recommended by staff, the proposed Basin Plan language would be changed.

2.2 Proposed Amendments to Basin Plan Chapter II (Existing and Potential Beneficial Uses)

The proposed modification to the Existing and Potential Uses Chapter is the addition of the commercial and sport fishing (COMM) beneficial use for Cache Creek and Bear Creek. The proposed change is the addition of a footnote to Basin Plan Table II-1 (Surface Water Bodies and Beneficial Uses) to indicate that commercial and sport fishing beneficial uses exist in Cache Creek (including North Fork) and Bear Creek in addition to the other beneficial uses listed in Table II-1. No deletions are proposed for Chapter II. The rational for the beneficial use designation is provided in Section 3 of this Staff report.

The proposed changes are stated in a new footnote in Table II-1 under the column "Surface Water Bodies" for the Cache Creek Clear Lake to Yolo Bypass entry to add "Cache Creek Clear Lake to Yolo Bypass (d)" and the addition of footnote "(d)" at the at the end of Table II-1 to read:
"(d) In addition to the beneficial uses noted in Table II-1, COMM exists for Cache Creek from Clear Lake to Yolo Bypass and only in the following tributaries: North Fork Cache Creek and Bear Creek."

2.3 Proposed Amendments to Basin Plan Chapter III (Water Quality Objectives)

The proposed modification to the Water Quality Objectives Chapter is the addition of site-specific, numeric water quality objectives for methylmercury in Cache Creek, Bear Creek, and Harley Gulch. No deletions are proposed for Chapter III. A detailed description and rational for the proposed water quality objectives are provided in Section 4 of this staff report.

Regional Board staff proposes that the following language to be added after the subheading **Methylmercury**:

For Clear Lake (53), the methylmercury concentration in fish tissue shall not exceed 0.09 and 0.19 mg methylmercury/kg wet weight of tissue in trophic level 3 and 4 fish, respectively. ~~*Compliance with these objectives shall be determined by analysis of fish tissue as described in Chapter V, Surveillance and Monitoring.*~~

For Cache Creek (Clear Lake to Yolo Bypass) (54), North Fork Cache Creek, and Bear Creek (tributary to Cache Creek), the average methylmercury concentration shall not exceed 0.12 and 0.23 mg methylmercury/ kg wet weight of muscle tissue in trophic level 3 and 4 fish, respectively. For Harley Gulch (tributary to Cache Creek), the average methylmercury concentration shall not exceed 0.05 mg methylmercury/ kg wet weight in whole, trophic level 2 and 3 fish.

Compliance with the methylmercury fish tissue objectives shall be determined by analysis of fish tissue as described in Chapter V, Surveillance and Monitoring.

2.4 Proposed Amendments to Basin Plan Chapter IV (Implementation)

The proposed modification to the Implementation Chapter is the addition of a water quality management strategy for mercury in the Cache Creek Watershed. The proposed modification adds a new subheading labeled **Cache Creek Watershed Mercury** and a description of a strategy to reduce mercury and methylmercury loads to Cache Creek, Bear Creek, and Harley Gulch, and Sulphur Creek. A detailed description of the water quality management strategy for mercury is provided in Section 5 of this staff report. No deletions are proposed for Chapter IV.

Regional Board staff proposes that the following language be added after the new subheading **Cache Creek Watershed Mercury**:

The Cache Creek watershed methylmercury and total mercury reduction implementation plan applies to Cache Creek (Clear Lake to the Settling Basin Outflow and North Fork from Indian Valley Reservoir Dam to the main stem creek), Bear Creek, Sulphur Creek, and Harley Gulch.

To protect the beneficial uses of Cache Creek and its tributaries, aqueous methylmercury concentrations and loads of total mercury into aquatic environments that generate methylmercury need to be reduced. This will be accomplished through a three-part process: 1) reduce loads of total mercury entering the water bodies by controlling discharges of mercury from and erosion at mercury mine sites, 2) determine sources of methylmercury production and develop plans to reduce methylmercury loads, and 3) control

discharges of sediments in watersheds where the total mercury concentrations in fine-grained sediment and soil are greater than 0.4 mg/kg, dry weight.

Methylmercury Load Allocations

Tables IV-7 and 8 provide methylmercury load allocations for Cache Creek, its tributaries, and instream methylmercury production. Allocations are expressed as a percent of existing methylmercury loads. The methylmercury allocations will be achieved by reducing the annual average aqueous methylmercury (unfiltered) concentrations to 0.14 ng/ L for Cache Creek, 0.06 ng/l for Bear Creek, and 0.09 ng/L for Harley Gulch.

Table IV-7
Cache Creek Methylmercury Allocations

Source	Existing Annual Load (gm/yr)	Acceptable Annual Load (gm/yr)	Allocation (% of existing load)
Cache Creek (Clear Lake to North Fork confluence)	36.8	11	30%
North Fork Cache Creek	12.4	12.4	100%
Harley Gulch	1.0	0.04	4%
Davis Creek	1.3	0.7	50%
Bear Creek @ Highway 20	21.1	3	14%
Within channel production and ungauged tributaries	49.5	32	65%
Margin of Safety		7	10% (a)
Cache Creek @ Yolo (b)	122	66	54%

a. Margin of safety is 10% of acceptable loads.
b. Includes 49.6 g/yr exported in agricultural diversions.

Table IV-8 provides the load allocation within Bear Creek and its tributaries to attain the allocation for Bear Creek described in Table IV-7.

Table IV-8
Bear Creek Methylmercury Allocations

Source	Existing Annual Load (gm/yr)	Acceptable Annual Load (gm/yr)	Allocation (% of existing load)
Bear Creek @ Bear Valley Road	1.7	0.9	50%
Sulphur Creek	8	0.8	10%
In channel production and ungauged tributaries	11.4	1	10%
Margin of Safety		0.3	10% (a)
Bear Creek at Hwy 20	21.1	3	15%

a. Margin of safety is 10% of acceptable loads.

The allocations in Tables IV-7 and IV-8 apply to sources of methylmercury entering each tributary or stream segment. In aggregate, the sources to each tributary or stream segment shall have reductions of methylmercury loads as shown above. To achieve the water quality objectives and methylmercury allocations listed in Tables IV-7 and IV-8, actions are required to: reduce mercury loads from inactive mines and stream sediments, reduce erosion of soils with elevated total mercury concentrations, and reduce instream production of methylmercury. Reducing sediment mercury concentrations is expected to result in reduced methylmercury production. Methylmercury allocations will be achieved in part by natural erosion processes that remove the large amounts of mercury that have deposited in creek bed and banks since the start of mining.

Actions are required to insure that future actions and activities of land use entities (agencies and private land owners) do not increase loads of total or methyl mercury to Cache Creek and tributaries. The focus of the implementation plan is to reduce inputs of total mercury from enriched areas (including the mine sites) in the upper watershed. Inputs of total mercury from enriched areas in the lower watershed (creek bed and banks) must not increase due to human activities.

Implementation of the load reductions will be accomplished using a phased approach. The first phase generally requires agencies and landowners in the upper watershed to conduct additional monitoring to further identify sources of methylmercury production and total mercury discharge and to develop feasibility studies for potential remediation projects. The second phase requires landowners to implement approved projects.

The Regional Water Board will participate in mercury and methylmercury source studies if resources are available. These studies include the following areas: Bear Creek, Cache Creek (Harley Gulch to Rumsey), Sulphur Creek, and Anderson Marsh.

Table IV-9 summarizes actions required and time schedules for studies and implementation of control plans. The Regional Water Board will consider adoption of conditional waivers or waste discharge requirements if reports and management plans are not submitted and implemented. The Regional Board will also issue appropriate enforcement orders to assist in achieving compliance with the water quality objectives.

Table IV-9 Implementation Summary

Implementation Project	Affected Watershed	Assigned Responsibility	Action	Completion Date
Inactive mercury mines	Harley Gulch, Sulphur Creek, Bear Creek	Mine Owners, USBLM	Remediate mines, sediment, and wetlands	2011
Creek sediments with elevated mercury	Sulphur Creek Bear Creek Cache Creek (Harley Gulch to Rumsey)	USBLM, SLC, CDFG, Colusa, Lake, and Yolo Counties, private landowners	Conduct additional studies Report on engineering options Conduct Projects (as required)	2006 2008 2011
Harley Gulch delta remediation	Harley Gulch	USBLM	Conduct additional studies Submit report on engineering options Conduct Projects (as required)	2006 2008 2011
Wetlands in former gravel excavations (new projects)	Lower Cache Creek	Yolo County or project proponents	Submit operational plans, estimate methylmercury inputs to creek Conduct Projects (as required)	(as wetlands projects are proposed)
Anderson Marsh	Cache Creek	California State Parks	Conduct additional studies Submit report on management options Conduct Project (as required)	2006 2008 2011
Erosion control in active channel, lower watershed	Cache Creek downstream of Rumsey	Yolo County, private landowners, USACOE	Implement erosion control or sediment containment plans	(as projects affecting active channel are proposed)
Management plans for erosion of mercury-enriched soil	Harley Gulch Sulphur Creek Bear Creek Cache Creek upstream of Rumsey	USBLM, SLC, CDFG, Colusa, Lake, and Yolo Counties, private landowners	Conduct additional studies Report on watershed activities Report on erosion control plans (as required) Implement erosion control plans (as required)	2008 2008 2010 2012

Inactive Mines

By December 2006 the Regional Water Board shall issue cleanup orders to control discharges from the inactive mines (Table IV-10) in the Cache Creek watershed. Total mercury loads from the individual mines shall be reduced by 95% of current loads associated with mining or other anthropogenic activities.

Table IV-10
Cache Creek Watershed Inactive Mines (a)

Abbott and Turkey Run Mines
Rathburn and Rathburn-Petray Mines
Petray North and South Mines
Wide Awake Mine
Central, Cherry Hill, Empire, Manzanita, and West End Mines
Elgin Mine
Clyde Mine

(a) The mines are grouped by current owner. Although remediation requirements apply to each mine site, a single owner or responsible party having adjacent sites may apply the 95% reduction to the total discharge from their sites.

The wetland immediately downstream from the Abbott and Turkey Run mines in Harley Gulch contains mercury and is a source of methylmercury. The mine owners and landowners shall remediate the wetlands to eliminate methylmercury loads as part of the mine cleanup.

The Sulphur Creek streambed and flood plain directly below the Central, Cherry Hill, Empire, Manzanita, West End and Wide Awake Mines contains mercury. As part of mine cleanup activities, the mine owners shall reduce anthropogenic mercury loading in the creek by 85%. Mercury and methylmercury loads produced by interaction of geothermal springs with mine wastes from the Turkey Run and Elgin mines shall be addressed as part of the mine cleanup.

Creek Sediment – Upper Watershed

Creek banks and creek sediments in Cache and Bear Creeks are significant sources of total mercury and methylmercury. Mercury in the banks of Cache Creek downstream of Harley Gulch is believed to originate from historic mining operations. The following requirements apply to sediments in Cache Creek from Harley Gulch to Rumsey, Bear Creek from Bear Valley Road (southern Bear Creek crossing) to Cache Creek, and Sulphur Creek downstream of Wilbur Hot Springs. Agencies responsible for developing monitoring and load reduction programs include US Bureau of Land Management (USBLM); State Lands Commission (SLC), California Department of Fish and Game (CDFG); Yolo, Lake, and Colusa Counties and private landowners. The agencies and landowners shall coordinate with the Regional Board to conduct studies to further refine total mercury and methylmercury sources. As sources are identified, the Regional Board will require landowners to submit a report that evaluates engineering options or management practices to reduce methylmercury concentrations and total mercury sediment concentrations. Emphasis of the evaluations shall be on control of erosion related to or increased by human activities. At completion of the studies and feasibility reports, the Regional Board will consider whether to require the landowners to implement a project.

The Regional Board and USBLM will conduct additional studies to determine the extent of mercury in sediment at the confluence of Harley Gulch and Cache Creek. The Regional Board will require USBLM

to evaluate engineering options to reduce erosion of this material to Cache Creek. If feasible projects are developed, the Regional Board will require USBLM to remediate the sediment.

New Reservoirs, Ponds, and Wetlands

Regional Water Board staff will review proposals for new impoundments for their potential of methylmercury production. Wetlands and new instream and off-stream water storage facilities shall be constructed and operated in a manner that would preclude a net increase in methylmercury concentrations entering Cache Creek or its tributaries.

Gravel mining pits in lower Cache Creek being reclaimed as ponds and wetlands shall be designed and operated to minimize methylmercury entering Cache Creek. If new reclamation projects result in an increase of methylmercury or total mercury discharged to Cache Creek, the project proponents shall submit a report of waste discharge and propose modifications or remediation projects. The Cache Creek Nature Preserve, which includes a wetland restored from a gravel excavation, may continue current practices of operation. Continuous flow of irrigation tail water through the Cache Creek Nature Preserve to Cache Creek is prohibited.

The Regional Board, in coordination with California State Parks (CSP), will continue to conduct methylmercury studies in Anderson Marsh. If the Regional Board finds that Anderson Marsh is a significant methylmercury source to Cache Creek, the Regional Board will require CSP to evaluate potential management practices to reduce methylmercury loads. The Regional Board will then consider whether to require CSP to implement a load reduction project.

Erosion Prevention – Upper Watershed

All road construction or maintenance projects by the California Department of Transportation (Caltrans) shall comply with the Caltrans statewide storm water permit and implement the highest level of management practices to control erosion. Water quality and sediment monitoring may be required to ensure compliance with this requirement. County and agency road departments shall implement the Caltrans or equivalent management practices to comply with these requirements. These requirements apply to road projects throughout the Harley Gulch and Sulphur Creek watersheds, the Bear Creek watershed south of the Bear Valley Road Crossing, and the Cache Creek watershed upstream of Camp Haswell.

A goal of the Regional Board is to minimize erosion from areas with enriched mercury concentrations. Enriched soil and sediment is defined as having an average concentration of mercury of 0.4 mg/kg, dry weight, in the silt/clay fraction. Cache Creek tributary watersheds with mercury-enriched soils include Harley Gulch, Judge Davis Creek, Crack Canyon, and Davis Creek. The Regional Board will conduct additional studies, in conjunction with landowners, to identify significant total mercury sources in upper Cache Creek (above Camp Haswell) and in tributaries to Bear Creek.

- After the Regional Board has identified sources in the tributaries, the Board will require those landowners and/or land managers to submit reports that identify anthropogenic activities on their lands that result in increased erosion (i.e., grazing, roads, timber harvest, mines). The Board will then require landowners and managers to submit erosion control plans and implement the plans after approval by the Executive Officer. Entities responsible for controlling erosion include US Bureau of

Land Management (USBLM); State Lands Commission (SLC), California Department of Fish and Game (CDFG); Yolo, Lake, and Colusa Counties and private landowners.

- Erosion from future anthropogenic activities in the enriched areas that results in increases of methylmercury or mercury loads from mercury-enriched areas is prohibited. For proposed changes in land use or other future activities, landowners must submit a plan including erosion estimates from the new project, erosion control practices, and, if a net increase in erosion is expected to occur, a mitigation plan.

Erosion Prevention – 10-Year Floodplains

Sediment in the depositional zone of the Cache Creek channel below mining areas is enriched in mercury (average in fine-grained sediment >0.4 mg/kg). All new projects within the 10-year floodplains of Cache Creek (from Harley Gulch to the Settling Basin outflow), Bear Creek (from tributaries draining Petray and Rathburn Mines to Cache Creek), Sulphur Creek, and Harley Gulch are prohibited from causing a net increase in erosion of mercury-enriched sediment. Compliance with the prohibition will be assessed by conducting monitoring during and after projects are implemented. Compliance will be measured by comparison of monitoring results with existing numeric water quality objectives for turbidity. Photodocumentation, surveying, or turbidity monitoring can be used to determine compliance with this requirement. Removal or remediation of sediment containing mercury from another part of the watershed would be acceptable to meet the "no net increase" standard if the project does or is anticipated to result in an increase of mercury discharge. Sediment removed from the channel must be placed outside of the floodplain so that it will not erode into the creek.

All bridge, culvert, or road construction or maintenance that may cause erosion within the 10-year flood plains must follow the Caltrans management practices or equivalent to control erosion, as described above.

Projects conducted strictly for the purposes of native riparian plant restoration or invasive species plant removal are required to use best management practices to prevent erosion. Projected conducted on stream banks must reestablish vegetation to prevent an increase in erosion or incorporate bioengineering or biotechnical stabilization practices into the project. If net erosion due to the project is observed or the above requirements are not met, then further monitoring and remediation will be required. Evaluation of net erosion should consider controllable factors contributing to erosion in the watershed.

Geothermal and Spring Sources

In general, geothermal springs that discharge mercury and sulfate may not be controllable. However, geothermal discharges adjacent to Sulphur Creek are potential candidates for remediation or mercury offset projects. As needed, the Executive Officer will make a determination of the suitability of geothermal source controls for offset or remediation projects.

The Wilbur Hot Springs resort is a source of mercury and methylmercury to Sulphur Creek. Discharges of mercury or methylmercury greater than existing loads are prohibited.

Mercury Offset Program and Alternative Load Allocations

The Regional Water Board recognizes that remediation of mines and non-point sources will require substantial financial resources. The Regional Water Board, therefore, will allow entities participating in approved mercury offset programs to conduct offset remediation projects in the Cache Creek watershed. Offset programs shall be focused on projects where funding is not otherwise available. Subject to approval by the Executive Officer, entities participating in an offset program may partner with agencies in mercury control actions. The framework for offset programs will be developed in future Basin Plan amendments.

The methylmercury load allocations in Tables IV-7 and 8 are assigned to watersheds. To allow offset program proponents to conduct projects within the watersheds to reduce loads, the Executive Officer may consider alternative load allocations that will achieve the objectives.

Public Education

The local county health departments will provide outreach and education regarding the risks of consuming fish containing mercury, emphasizing portions of the population that are at risk, such as pregnant women and children.

Adaptive Implementation

The Regional Water Board will review the progress toward meeting the Cache Creek goals and water quality objectives every five years. The Regional Water Board recognizes that there are uncertainties with the load estimates and the correlation between reductions in loads of total mercury, methylmercury uptake by biota, and fish tissue concentrations. Using an adaptive management approach, the Regional Water Board will evaluate new data and scientific information to determine the most effective control program and allocations to reduce methylmercury and total mercury sources in the watershed.

Monitoring and Review

The monitoring plan for Cache Creek is described in Chapter V, Surveillance and Monitoring. Regional Water Board staff will oversee the preparation of detailed monitoring plans and resources to conduct monitoring of sediment, water, and fish to assess progress toward meeting the water quality objectives.

2.5 Proposed Amendments to Basin Plan Chapter V (Surveillance and Monitoring)

The proposed modification to the Surveillance and Monitoring Chapter includes a monitoring program for total mercury and methylmercury in the Cache Creek watershed for the purposes of determining compliance with the proposed water quality objectives. The description of the monitoring program is provided in Section 6 of this report.

The existing monitoring program for mercury in Clear Lake has been rearranged for clarity and no significant changes are proposed for the Clear Lake section. Regional Board staff proposes to add a new heading to Chapter V titled "**Mercury and Methylmercury**" and a subheading titled "**Cache Creek"** and the following language to describe the monitoring program.

~~**Clear Lake Methylmercury**~~

~~The Regional Water Board will use the following criteria to determine compliance with the methylmercury fish tissue objectives in Clear Lake. Mercury will be measured in fish of the species and sizes consumed by humans and wildlife. The objectives are based on the average of methylmercury concentrations in muscle tissue of trophic level 3 and 4 fish. Because greater than 85% of total mercury in muscle tissue of fish of these sizes is methylmercury, analysis of muscle tissue for total mercury is acceptable for assessing compliance.~~

~~Fish from the following species will be collected and analyzed every ten years. The representative fish species for trophic level 4 shall be largemouth bass (total length 300-400 mm), catfish (total length 300 – 400 mm), brown bullhead (total length 300-400 mm), and crappie (total length 200-300 mm). The representative fish species for trophic level 3 shall be carp, hitch, Sacramento blackfish, black bullhead, and bluegill of all sizes; and brown bullhead and catfish of lengths less than the trophic level 4 lengths.~~

~~Fish tissue mercury concentrations are not expected to respond quickly to remediation activities at Sulphur Bank Mercury Mine, Clear Lake sediments, or the tributaries. Adult fish integrate methylmercury over a lifetime and load reduction efforts are not expected to be discernable for more than five years after remediation efforts. Therefore to assess remedial activities, part of the monitoring at Clear Lake will include indicator species, consisting of inland silversides and largemouth bass less than one year old, to be sampled every five years. Juveniles of these species will reflect recent exposure to methylmercury and can be indicators of mercury reduction efforts.~~

~~Average concentrations of methylmercury by trophic level should be determined in a combination of the identified species collected throughout Clear Lake. The number of fish collected to determine compliance with this objective will be based on the statistical variance within each species. The sample size will be determined by methods described in USEPA's Guidance for Assessing Chemical Contaminant Data for Use in Fish or other statistical methods approved by the Executive Officer.~~

~~Total mercury in tributary sediment, lake sediment, and water will be monitored to determine whether loads have decreased. The water and sediment monitoring frequency will be every five years.~~

Mercury and Methylmercury

The Regional Water Board will use the following criteria to determine compliance with the methylmercury fish tissue objectives. Site-specific criteria for various water bodies are described below.

In general, the objectives are based on the average of methylmercury concentrations in muscle tissue of trophic level (TL) 3 and 4 fish as appropriate. Because greater than 85% of total mercury in muscle tissue of fish of these sizes is methylmercury, analysis of muscle tissue for total mercury is acceptable for assessing compliance. Mercury will be measured in fish of the species and sizes consumed by humans and wildlife.

The number of fish collected to determine compliance with the methylmercury objective will be based on the statistical variance within each species. The sample size will be determined by methods described in USEPA's Guidance for Assessing Chemical Contaminant Data for Use in Fish or other statistical methods approved by the Executive Officer.

Compliance with the fish tissue objective is achieved when the average concentrations in local fish are equivalent to the respective objective for three consecutive years.

Clear Lake

Fish from the following species will be collected and analyzed every ten years. The representative fish species for trophic level 4 shall be largemouth bass (total length 300-400 mm), catfish (total length 300 – 400 mm), brown bullhead (total length 300-400 mm), and crappie (total length 200-300 mm). The representative fish species for trophic level 3 shall be carp, hitch, Sacramento blackfish, black bullhead, and bluegill of all sizes; and brown bullhead and catfish of lengths less than the trophic level 4 lengths.

Fish tissue mercury concentrations are not expected to respond quickly to remediation activities at Sulphur Bank Mercury Mine, Clear Lake sediments, or the tributaries. Adult fish integrate methylmercury over a lifetime and load reduction efforts are not expected to be discernable for more than five years after remediation efforts. To assess remedial activities, part of the monitoring at Clear Lake will include indicator species, consisting of inland silversides and largemouth bass less than one year old, to be sampled every five years. Juveniles of these species will reflect recent exposure to methylmercury and can be indicators of mercury reduction efforts.

Average concentrations of methylmercury by trophic level should be determined in a combination of the identified species collected throughout Clear Lake.

Total mercury in tributary sediment, lake sediment, and water will be monitored to determine whether loads have decreased. The water and sediment monitoring frequency will be every five years

Cache Creek, Bear Creek, and Harley Gulch

The Regional Water Board will use the following criteria to determine compliance with the methylmercury fish tissue objectives in Cache and Bear Creeks. Compliance with the respective objectives shall be determined based on fish tissue analysis in Cache Creek from Clear Lake to the settling basin, North Fork Cache Creek, and Bear Creek upstream and downstream of Sulphur Creek.

The representative fish species for each trophic level shall be:

- Trophic Level 3: green sunfish, bluegill, and/or Sacramento sucker (rainbow trout also an option for North Fork Cache Creek);
- Trophic Level 4: Sacramento pikeminnow, largemouth bass, smallmouth bass and/or channel catfish.

The sample sets should include at least two species from each trophic level (i.e., bass and Sacramento pikeminnow, for TL4) collected at each compliance point or stream section. The samples should include a range of sizes of fish between 250 and 350 mm, total length, averaging 300 mm. Green sunfish and bluegill may not be available in this range; therefore those sampled should be greater than 125 mm total length. If two species per trophic level are not available and are unlikely to be present given historical sampling information, one species is acceptable (the only TL4 species typically in North Fork is Sacramento pikeminnow).

Compliance with the Harley Gulch methylmercury water quality objective will be determined using hardhead, California roach, or other small (TL2/3), resident species in the size range of 75-100 mm total length.

Aqueous methylmercury goals are in the form of the annual average concentration in unfiltered samples. For comparison of methylmercury concentration data with aqueous methylmercury goals, water samples should be collected periodically throughout the year. The samples should be collected during typical flow conditions as they vary by season, rather than targeting extreme low or high flow events. Aqueous methylmercury data may be collected by Regional Board staff or required of project proponents.

Monitoring for mine and remediation projects or other activities that are expected to significantly affect methylmercury or mercury loads shall include:

- Monitoring parameters for soil and sediment should be total mercury in soil or sediment, silt/clay (<65 microns) fraction.

- Monitoring parameters for water should include: methylmercury (if project is methylmercury source), total mercury, total suspended solids, and stream flow. Water sampling in major tributaries must include high flow events for mercury and total suspended solids. More frequent monitoring (two to four significant storm events for three consecutive years) is required post remediation to evaluate the effectiveness of cleanup projects and compliance with load allocations.

3 BENEFICIAL USES AND EXISTING CONDITIONS

3.1 Cache Creek Beneficial Uses Cited in the Basin Plan

Both the federal Clean Water Act and the California Water Code (Porter-Cologne Water Quality Act) require identification and protection of beneficial uses. Beneficial uses are designated by the Regional Water Quality Control Board and are shown in Table II-1 of the Water Quality Control Plan for the Sacramento and San Joaquin Basins (Basin Plan) (CVRWQCB, 1998). The designated beneficial uses are intended to meet all applicable State and federal requirements. Table 3.1 lists the existing and potential beneficial uses of Cache Creek (Clear Lake to Yolo Bypass). Cache Creek provides habitat for warm water species of fish and their associated aquatic communities. Cache Creek and its riparian areas provide valuable wildlife habitat. There is significant use of Cache Creek for swimming, fishing, rafting, and picnicking. In addition, water is diverted from Cache Creek for agricultural use. The beneficial uses of Cache Creek that are impaired due to high mercury levels are recreational fishing (REC-1), municipal and domestic supply (MUN), and wildlife habitat (WILD). High mercury levels in fish pose risks for humans and wildlife that consume fish from the creeks.

Beneficial uses are not specified in the Basin Plan for Bear Creek, Sulphur Creek, or Harley Gulch. According to the Basin Plan, "beneficial uses of any specifically identified water body generally apply to its tributary streams."[1] By application of this policy, beneficial uses for Cache Creek are applicable to Bear Creek, Sulphur Creek, and Harley Gulch. Under the Sources of Drinking Water Policy (State Water Resources Control Board Resolution 88-63), the municipal and domestic supply designation (MUN) applies to these water bodies.

Table 3.1. Existing and Potential Beneficial Uses of Cache Creek (Clear Lake to Yolo Bypass)

Beneficial Use	Status
Municipal and domestic supply (MUN)	Existing (a)
Agriculture – irrigation and stock watering (AGR)	Existing
Recreation – contact (REC-1) and other non-contact (REC-2)	Existing (a)
Industry- process (PROC) and service supply (IND)	Existing
Freshwater habitat (Warm)	Existing
Spawning (SPWN) – warm and cold	Existing
Wildlife habitat (WILD)	Existing (a)
Freshwater habitat (Cold)	Potential

(a) Beneficial uses impaired by mercury in Cache Creek (CVRWQCB, 1998).

[1] This policy is commonly called the tributary rule. The Basin Plan states the following: "The beneficial uses of any specifically identified waterbody generally apply to its tributary streams. In some cases, a beneficial use may not be applicable to the entire body of water. In these cases, the Regional Board's judgment will be applied." Water bodies within the Basins that do not have beneficial uses designated "…are assigned MUN designations in accordance with the provisions of State Water Resources Control Board Resolution No. 88-63…" (CVRWQCB 1998, Chapter 2). This resolution states that, "All surface and ground waters of the State are considered to be suitable, or potentially suitable, for municipal or domestic water supply and should be so designated by the Regional Boards…". The entire Basin Plan is available on the internet: http://www.waterboards.ca.gov/centralvalley/available_documents/index.html

The Cache Creek watershed provides habitat for diverse populations of wildlife. Raptors that forage in the riparian area include bald eagle, golden eagle, osprey, and peregrine falcon. Other birds that inhabit the riparian zone include great blue heron, snowy egret, green heron, belted kingfisher, and common merganser. Northern river otter, raccoon, American marten, American mink, tule elk, mountain lion, and black bear are also found in the Cache Creek watershed (USBLM, 2002).

Clear Lake and Indian Valley Reservoir allow for year round flow to Cache Creek upstream of Capay, providing essential habitat for the local fish species. Cache Creek is home to warm water and cold water, game and non-game fish, which include rainbow and brown trout, channel catfish, smallmouth bass, Sacramento pikeminnow, Sacramento sucker, carp, and California roach. Anadromous fish such as steelhead trout and Pacific lamprey made their way up Cache Creek to spawn in Clear Lake tributaries prior to the construction of the Cache Creek dam (Moyle, 2002). It is unknown whether anadromous fishes still ascend Cache Creek.

3.2 Existing Conditions

3.2.1 Mercury in Fish Tissue

High levels of mercury in fish are of concern to humans and wildlife that eat fish from Cache Creek and Bear Creek. Table 3.2, below, summarizes average concentrations of methylmercury in fish tissue for Cache and Bear Creeks. More detailed data are included in the TMDL report. Most fish samples were collected in 1997 and 2000.

Table 3.2 Average Concentrations of Methylmercury in Fish in the Cache Creek Watershed (mg/kg, wet weight)

	Fish Trophic Level 2/3, length 50-150 mm (eaten by kingfisher, otter and cormorant) (a)	Fish Trophic level 3, length 150-350 mm (eaten by grebe and merganser) (a)	Fish Trophic Level 3 >150 mm (eaten by bald eagle, osprey, & human) (a)	Fish Trophic Level 4 >150 mm (eaten by bald eagle, osprey, & human) (a)
Cache Creek: Clear Lake to North Fork confluence	0.06	0.09	0.16	0.31
North Fork Cache Creek (b)	0.07	0.14	0.19	0.16
Cache Creek @ Rumsey	0.10	0.36	0.36	0.54
Cache Creek d/s Capay Dam	0.08	0.26	0.28	0.44
Bear Creek u/s Sulphur Creek	0.12	0.24	0.24	0.72
Bear Creek d/s Sulphur Creek	0.69	1.31	1.31	3.15
Harley Gulch	0.34	Not available	Not available	Not available

a. Data sources: CDFG 2004; Davis, 1998; Slotton *et al.*, 1997, 2004; SWRCB 2002;
b. The fish concentration in large TL3 fish sampled from North Fork Cache Creek is greater than the concentration in large TL4 fish, presumably because the TL3 fish sampled were larger than the TL4 fish.

3.2.2 Data for Other Wildlife

Wildlife species may experience neurological, reproductive or other detrimental effects from methylmercury exposure. Although a few studies indicate that methylmercury impairs reproduction of fish species (Matta *et al.*, 2001), the greatest concern for toxicity is in organisms that consume fish. Behavioral effects including impaired learning, reduced social behavior and impaired physical abilities have been observed in mice, otter, mink and macaques exposed to methylmercury. Reproductive impairment following methylmercury exposure has been observed in multiple species, among them common loons and western grebe (Wolfe *et al.*, 1998). Adverse reproductive effects have been observed in loons and mink after feeding on fish containing concentrations of methylmercury similar to those found in Cache Creek (0.3-0.5 mg/kg; Barr, 1986; Halbrook *et al.*, 1997).

There have been no studies conducted to date showing adverse effects of methylmercury on wildlife species in the Cache Creek watershed. However estimates of methylmercury intake by piscivorous species eating fish from Cache and Bear Creeks and/or Harley Gulch are higher than safe levels of intake for these species as derived from published literature.

3.2.3 Water and Sediment Data

Water data are summarized in Table 3.3, which shows the median and range of concentrations of total recoverable mercury in Cache Creek and tributaries. Higher mercury concentrations occur during storm water runoff events and at mine site tributaries. Concentrations range from less than 1 ng/l to greater than 8400 ng/l.

Regional Board staff and others have collected sediment data in various sections of Cache Creek, Bear Creek, Sulphur Creek, and Harley Gulch. Sediment mercury concentrations are elevated in locations at and downstream of the mercury mines. Background sediment concentrations range between 0.1 and 0.3 mg/kg, dry weight (Churchill and Clinkenbeard, 2004; Foe and Croyle, 1998; unpublished data collected by the CVRWQCB), while downstream of the mines the concentration within Cache and Bear Creeks can range up to 12 mg/kg (See TMDL reports in Appendices). Below the mines sites, concentrations of mercury in fine-grained sediment may be 2 to 3-fold higher than in the main stem of the creeks (Table 3.4).

Table 3.3 Mercury in Cache Creek Water Samples

Sampling Location (upstream to downstream)		Number of Samples [(a)]	Range of Concentrations Total Recoverable Mercury (ng/L)	Median Concentration of Total Recoverable Mercury (ng/L)
Upper Basin	Cache Creek @ Cache Creek Dam	26	0.3 to 34.9	7.5
	North Fork Cache Creek @ Hwy 20	29	1.3 to 1,381	5.1
Mine Site Tributary Inputs	Harley Gulch at USGS Gauge (near Highway 20)	20	29.5 to 831	197
	Sulphur Creek at USGS Gauge	23	376 to 8,402	1,051
	Davis Creek at USGS Stream Gauge (downstream of Davis Creek Reservoir dam)	6	3.1 to 29.8	7.4
Upper Basin	Bear Creek at USGS Gauge	16	18.5 to 1,290	81.9
Lower Basin	Cache Creek @ Rumsey	65	2.3 to 2,248	17.6
	Cache Creek @ Capay Dam	4	5.7 to 3,004	25.8
	Cache Creek @ Road 102 (upstream of Settling Basin)	44	1.2 to 1,295	29.3

(a) Sources: Foe & Croyle (1998), Suchanek, *et al.* (2004), Domagalski, *et al.* (2004)

Table 3.4 Five-Year Average Concentration of Mercury in Suspended Sediment for Selected Locations in the Cache Creek Drainage.

	Cache Creek: Clear Lake to North Fork confluence	North Fork Cache Creek	Harley Gulch	Davis Creek	Bear Creek	Cache Creek canyon and unnamed tributary Source(s) Above Rumsey	Cache Creek at Rumsey	Cache Creek at Yolo	Settling Basin Outflow
Mercury in suspended sediment (mg/kg, dry weight)	0.2	0.2	350	2.0	2.5	1.3	1.0	0.5	0.5

(a) Concentration of mercury in suspended sediment determined as the ratio of concentration of total mercury (unfiltered) in water to concentration of total suspended sediment (TSS) in water. See Section 3 of Cache Creek TMDL report.

3.3 Proposed Modification to Basin Plan for Existing and Potential Beneficial Uses to Include Commercial and Sport Fishing (COMM)

As noted in Section 3.1, the Basin Plan lists the existing and potential uses of Cache Creek. The Basin Plan provides a standard definition for commercial and sport fishing (COMM). The COMM designation is defined as "uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes." (CVRWQCB, 1998). The current Basin Plan does not include the commercial and sport fishing (COMM) designation for Cache Creek, Clear Lake to Yolo Bypass.

The proposed addition of COMM to Cache Creek (Clear Lake to Yolo Bypass), North Fork Cache Creek, and Bear Creek would clarify the existing uses of the creeks. Sport fishing is a past and present use of Cache and Bear Creeks. There are no known commercial fisheries in the watershed.

To obtain information about sport fishing in the Cache Creek watershed, Regional Board staff interviewed the area CDFG warden. Staff accompanied the warden on a tour of access sites and likely angling spots (CDFG, 2004c; 2005). Staff also spoke with the USBLM personnel managing the Cache Creek Natural Area (upper watershed; USBLM, 2002). Sport fishing is common at several places along Cache Creek. Cache Creek downstream of Anderson Marsh to the Clear Lake Dam is mostly private property and angling is limited to residents along the creek or people fishing from boats. The Cache Creek canyon area, between Highway 20 and Highway 16, is largely inaccessible making access to fishing spots difficult. Anglers have been observed in North Fork Cache Creek and Bear Creek in limited numbers, however; the length of Cache Creek between the confluence with Bear Creek and the town of Capay is the most popular for angling. Several Yolo County parks and road crossings provide easy access. Most of the property between these areas as well as from Capay to the Cache Creek Settling Basin is private and closed to public use. During water sampling events, Regional Board staff has regularly observed people fishing in Cache Creek at the Road 102 crossing prior to the entrance of the Cache Creek Settling Basin.

Fishing in Cache Creek occurs year round with peak fishing taking place in the spring and summer. Between a half dozen and a dozen people can be observed angling at popular sites along the creek during peak times (CDFG, 2004c). Most people fishing the creek are local residents but do not make Cache Creek their sole place for sport fishing.

Bullhead and channel catfish are the predominant sport fish in Cache Creek. Smallmouth and largemouth bass are also caught and kept. Sizes of fish kept by anglers vary. Typical bass caught are in the range of 8-10 inches (200-250 mm); catfish tend to be larger (CDFG, 2005). CDFG sport fishing regulations for Cache Creek do not restrict catfish sizes or bag limits, while bass have a five-bag limit and no size restrictions. Most fish caught in the creek are kept and intended for consumption. Brown and rainbow trout can be found in North Fork Cache Creek. Fishing pressure in the North Fork is unknown. Rainbow trout also occur in the upper watershed of Bear Creek, but the creek is closed to trout angling.

4 WATER QUALITY OBJECTIVES

Water quality objectives are established in Basin Plans by the California Regional Water Quality Boards to reasonably protect beneficial uses. Water quality objectives provide a specific basis for the measurement and maintenance of water quality.

The Basin Plan for the Sacramento and San Joaquin Rivers does not contain numeric water quality objectives for methylmercury in Cache Creek or its tributaries. For this proposed Basin Plan amendment, site-specific numeric water quality objectives are evaluated for Cache Creek, Bear Creek, and Harley Gulch. The proposed objectives are presented as methylmercury concentrations in fish tissue.

Fish tissue methylmercury objectives are not proposed for Sulphur Creek, as fish are not present in the vicinity of the naturally occurring thermal springs (CDFG, 2004d; Moyle, 2004). To guide remediation efforts, the implementation plan proposed in Section 5.2 discusses sediment goals that are applicable to Sulphur Creek. The proposed goals were developed based on background mercury concentrations in sediment and the geothermal springs adjacent to and within the creek.

Numerical guidelines and recommended criteria are available from USEPA and other agencies for the development of water quality objectives for mercury. Regional Water Board staff reviewed these numerical guidelines during the preparation of the alternatives listed below. Regional Water Board staff also received guidance from the US Fish and Wildlife Service (USFWS; See Appendix of Cache Creek TMDL report)

The USEPA promulgated the California Toxic Rule (CTR) in April 2000 (USEPA, 2000a). The CTR contains a water quality criterion of 50 ng/L total recoverable mercury for freshwater sources of drinking water. The CTR criterion protects humans from exposure to mercury in drinking water and fish containing mercury. The standard is enforceable for all waters with a municipal and domestic water supply and/or any aquatic beneficial use designation. The CTR criterion currently applies to Cache Creek and tributaries. When applied to discharge permits, the CTR criterion is interpreted as a 30-day running average concentration that may be exceeded only once in three years. Daily measurements of mercury in Cache Creek have not been made. Because storm-related flows generate high turbidity, however, estimates by Regional Board staff predict that the CTR is exceeded in Cache Creek when multiple storm events occur in a 30-day period. The implementation plan (Section 5) focuses on erosion control and significant reductions from the mine sites of inputs of soil with high concentrations of mercury, which will decrease aqueous concentrations of mercury in the creek during storms. The implementation plan is intended to comply with all applicable standards.

The CTR is likely exceeded frequently in Sulphur Creek from geothermal (year-round) and storm-related inputs (See Appendices A and B). Compliance with the CTR and possible beneficial use adjustment is discussed further in Section 4.2.8.

Although the CTR criterion applies to the Cache Creek watershed, objectives for methylmercury in fish tissue are considered to be more stringent. Fish tissue objectives more directly protect the beneficial uses for humans and wildlife that consume fish. Further comparison of the CTR with fish tissue objectives is provided in Section 4.3.

4.1 Water Quality Objective Alternatives Considered- Cache Creek, Bear Creek, Harley Gulch

Four alternatives were considered in developing water quality objectives for the regulation of methylmercury in fish in Cache and Bear, and Harley Gulch. For the purposes of this staff report, a sample calculation for fish tissue objectives is shown in the text below. Complete calculations for Alternative 2 are provided in the Cache Creek, Bear Creek, and Harley Gulch TMDL for Mercury (Appendix A). Calculations for Alternatives 3 and 4 are described below and in Appendix E.

4.1.1 Alternative 1. No Action

If no site-specific objectives are adopted for mercury in Cache Creek, Bear Creek, and Harley Gulch, the narrative objective of the Basin Plan still applies (See Section 1.2). The primary criterion that would likely be used to interpret the narrative objective is the CTR criterion for total mercury. The Basin Plan contains no criterion for methylmercury, although the Basin Plan was recently amended to include a site-specific methylmercury fish tissue objective for Clear Lake.

The following alternatives propose numerical water quality objectives that clarify the narrative objective and facilitate implementation of a water quality management strategy to reduce methylmercury in this watershed. Numeric objectives for Cache Creek, Bear Creek, and Harley Gulch are needed to assess progress in attaining the beneficial uses. In particular, the implementation plan proposed as part of the Basin Plan Amendment is based upon numeric targets and quantitative reductions required to meet those goals.

4.1.2 Alternative 2. Site-Specific Objectives of Methylmercury Concentrations in Trophic Level 2, 3, and 4 Fish to Protect Humans and Wildlife Species (0.05, 0.12, and 0.23 mg/kg, wet weight, respectively)

Alternative 2 consists of water quality objectives for methylmercury in fish tissue. The proposed water quality objectives for Alternative 2 would consist of site-specific methylmercury concentrations in fish tissue that would be fully protect wildlife in the Cache Creek watershed. The proposed objectives for Cache Creek and Bear Creek are specified in terms of fish trophic level (trophic levels 3 and 4) and size[2]. The proposed objective for Harley Gulch is for small trophic level 2 or 3 fish, less than a specific size. The objectives for Cache and Bear Creeks are discussed separately from the Harley Gulch objective. All calculations are shown in Section 2 of the Cache Creek TMDL report (Appendix A).

Fish-eating birds and mammals are potentially at risk for impairments caused by consumption of fish containing mercury. Acceptable fish tissue levels of mercury for wildlife species can be calculated by

[2] Trophic levels are the hierarchical strata of a food web characterized by organisms that are the same number of steps removed from the primary producers. The USEPA Mercury Study Report to Congress used the following criteria to designate trophic levels based on an organism's feeding habits (USEPA 1997):
Trophic level 1: Phytoplankton.
Trophic level 2: Zooplankton, benthic invertebrates, and fish that eat phytoplankton.
Trophic level 3: Organisms that consume zooplankton, benthic invertebrates and/or herbivorous fish.
Trophic level 4: Organisms that consume trophic level 3 organisms.

incorporating daily intake levels, body weights, consumption rates, and trophic level and size of fish consumed. The USFWS provided guidance to Regional Board staff regarding the methodology and details about each wildlife species of concern used in development of the Alternative 2 objectives (USFWS, 2004).

Wildlife species most likely at risk for mercury toxicity are primarily or exclusively piscivorous. Wildlife species of concern in the Cache Creek watershed are American mink, river otter, bald eagle, belted kingfisher, common merganser, double-crested cormorant, osprey, and western grebe. Because peregrine falcons consume piscivorous birds, they are also of concern for excess mercury exposure (CDFG, 2002; Linthicum, 2003; USBLM, 2002).

Cache and Bear Creek Objectives

For Alternative 2, the acceptable daily intake level (reference dose) for mammals and avian species were used based on studies in which wildlife was exposed to methylmercury and effects were monitored. The Cache Creek TMDL report (Appendix A) provides rationale and citations for the reference doses, and estimated animal body weights and fish consumption rates that were used to calculate safe fish tissue levels for the Alternative 2 objectives. These variables can be related by the following equation:

Equation 1

$$\frac{\text{Safe daily intake (reference dose)} * \text{Consumer's body weight}}{\text{Consumption rate}} = \text{Acceptable mercury level in fish tissue}$$

Using this equation, staff computed average safe concentrations of methylmercury in fish that would protect wildlife consuming those fish. The TMDL evaluated safe concentrations of methylmercury in fish consumed by kingfisher, mink, merganser, cormorant, grebe, otter, falcon, osprey, and bald eagle[3]. The Cache Creek TMDL report shows how the safe level of mercury in prey fish varied between fish trophic level and length.

Alternative 2 proposes site-specific water quality objectives that reasonably protect prey fish and piscivorous birds and mammals in Cache Creek and Bear Creek. Alternative 2 is the same as the concentrations derived in the target section of the TMDL report. Therefore, the proposed objectives are:

0.12 mg methylmercury/kg wet weight in large, trophic level 3 fish, and

0.23 mg methylmercury/kg wet weight in large, trophic level 4 fish.

These proposed concentrations in fish would protect the federally listed bald eagle. If these objectives were achieved, methylmercury intakes by other piscivorous wildlife, including river otter and belted

[3] In the Cache Creek, Bear Creek, and Harley Gulch TMDL report, Regional Board staff also provides safe methylmercury concentrations in piscivorous and omnivorous birds preyed upon by bald eagles and peregrine falcons. Although the baseline data set for methylmercury in fish is substantial, existing concentrations in avian prey are not known. Because humans do not consume the avian prey, it would be difficult to determine whether meeting a safe concentration in avian prey is protective of human fish consumers. For these reasons, Regional Board staff is not proposing tissue objectives for avian prey species. The USFWS concluded that meeting the above proposed fish tissue objectives would adequately reduce methylmercury levels in the avian prey species that eat fish or invertebrates from these watersheds.

kingfisher, would be expected to be at or below safe levels. These proposed concentrations are the average methylmercury concentrations in fillet of TL3 fish in the range 150-350 mm total length and TL4 fish in the range of 150-500 mm total length. The large size range corresponds with the range of fish potentially consumed by humans or wildlife species. A more narrow size range of 250-350 mm total length is proposed in the Basin Plan amendment language for evaluating compliance with the objectives.

Safe levels of methylmercury in fish can be developed to protect humans in a manner analogous to levels to protect wildlife[4]. The water quality objectives proposed for Alternative 2 would also protect humans consuming fish from Cache Creek. The TMDL report determined that at the proposed objectives, humans could consume 22-29 gm/day of fish from Cache and or Bear Creeks (3-4 eight-ounce meals of fish per month). The safe intake rate ranges, depending on Cache Creek species consumed and assuming the consumers eat the national average of 12.5 g/day of commercial fish. This is greater than the USEPA default value for the general population of 17.5 gm/day (2.3 meals/month). The Cache and Bear Creek safe consumption rates, however, are less than the USEPA recommended rate (142 gm/day; equivalent to 19 meals/month) to protect subsistence angers. The extent of subsistence angling in Cache and Bear Creeks is unknown.

Harley Gulch Objective

Harley Gulch is an ephemeral stream with some small pools that support small fish, turtles, newts and invertebrates through the year. Dry stretches of the stream and a natural rock wall approximately two miles from the mouth are barriers to larger fish moving from Cache Creek into Harley Gulch except during flooding. Deer, livestock and other species utilize Harley Gulch for drinking water.

Cache Creek wildlife beneficial uses applicable to Harley Gulch are warm freshwater habitat and wildlife habitat. Wildlife habitat, specifically consumption of aquatic organisms by wildlife species, is the beneficial use that is most impacted by mercury. Harley Gulch has limited habitat for piscivorous birds or mammals. Wildlife species likely feeding at the stream are kingfisher, small herons, and raccoon. Because of the ephemeral character of the stream and the mobility of these predators, it is likely that these species do not feed exclusively in Harley Gulch.

The levels of methylmercury in aquatic organisms in Harley Gulch prior to operation of the upstream mercury mines are unknown. The proposed goal for Harley Gulch is to remove mine inputs and restore the stream to pre-mining conditions. Removal of the anthropogenic mercury sources will reduce total mercury in the stream; this is expected to decrease methylmercury concentrations to a natural or background level.

The Alternative 2 water quality objective for Harley Gulch is the level of methylmercury in fish tissue to protect organisms consuming aquatic species from Harley Gulch. Because only small fish (likely TL2 or TL3) fish have been observed in Harley Gulch, the safe fish level for small, TL2/3 fish calculated in the TMDL report is proposed for the objective. The TMDL determined that the safe concentration of

[4] Calculation of the safe fish tissue levels to protect humans used the same reference dose, adult body weight, and intake of methylmercury from commercial fish, as described in the Alternative 3 objectives. The difference between the Alternative 2 and Alternative 3 objectives, in terms of human health protection, is that Alternative 2 allows for a higher rate of consumption of local fish.

methylmercury in fish tissue to protect the kingfisher 0.05 mg/kg. Therefore, the proposed objective is for Harley Gulch is:

0.05 mg methylmercury /kg, wet weight, for trophic level 2/3 fish.

This proposed objective should protect wildlife species consuming fish from Harley Gulch. These proposed concentrations are the average methylmercury concentrations in whole trophic level 2 or 3 fish in the range of 75-100 mm total length. Because of the small fish size (< 4 inches), humans are not expected to eat fish from Harley Gulch and therefore this report does not evaluate human consumption rates of these fish.

4.1.3 Alternative 3. Objectives for Cache Creek and Bear Creeks based on the USEPA's Recommended Water Quality Criterion for Methylmercury, assuming mainly TL4 consumption (0.15 and 0.3 mg/kg, wet weight in Trophic Level 3 and 4 fish, respectively)

Alternative 3 proposes water quality objectives for Cache Creek and Bear Creek based on the USEPA's Recommended Water Quality Criterion for Methylmercury. To protect human health, the USEPA recommends an ambient water quality criterion for methylmercury of 0.3 mg/kg methylmercury in fish tissue, on a wet weight basis (USEPA, 2001). The USEPA criterion represents the concentration in fish tissue that should not be exceeded based on a total consumption of locally caught fish of 17.5 g/day[5]. A level of 17.5 g/day is the consumption rate reported by the 90th percentile of participants in a 1994-96 nation-wide food survey conducted by the U.S. Department of Agriculture (including people who do not eat fish). The 17.5 g/day rate originated from the sum of particular amounts of fish from trophic levels 2, 3, and 4. The USEPA criterion assumes consumers eat 12.5 g/day of fish obtained from commercial sources (mainly marine fish), in addition to the locally caught fish. The estimated intake of methylmercury from other sources, such as drinking water, other foods and air, is negligible (USEPA, 2001). See Appendix E for complete calculations for the Alternative 3 objectives.

The following equation was used for calculation of USEPA's recommended fish-tissue based methylmercury water quality criterion (USEPA, 2001):

Equation 2

$$\frac{(\text{RfD} - \text{intake from other sources}) * \text{body weight}}{\text{Local fish consumption rate}} = \text{Acceptable level of mercury in fish}$$

Where: RfD = reference dose for humans, representing the safe, total daily intake of methylmercury (0.1 micrograms/kg body weight per day).

Intake from other sources = average intake of methylmercury from marine fish by adults in the general population

Local fish consumption rate = 17.5 g/day

Application of USEPA's reference dose and default consumption rates to Equation 2:

[5] 17.5 g/day is equivalent to one eight-ounce meal per 2-week period, or four ounces per week (2.3 meals/month). 12.5 g/day is equivalent to 1.7 eight-ounce meals per month.

$$\frac{(0.10\ \mu g/kg\ day - 0.027\ \mu g/kg\ day) * 70\ kg}{(17.5\ g/day)} = 0.3\ \mu g\ methylmercury/g\ fish\ tissue$$

Note: 0.3 µg/g fish tissue is equivalent to 0.3 mg/kg.

The initial USEPA methylmercury criteria report did not describe how the criterion should be applied to fish species with different concentrations of methylmercury. The USEPA strongly encourages, however, that the criterion be applied using information about local consumption (USEPA, 2001). The CDFG Warden for the Cache Creek area has reported that the primary species of fish caught and kept by anglers are bass, bullhead catfish, and channel catfish (CDFG, 2004c). Bass and channel catfish are TL4 species. Bullhead catfish are slightly lower on the food web (may be classified as TL4-3), as they typically consume a mix of TL2 and TL3 prey (Moyle, 2004). Humans are unlikely to consume trophic level 2 fish or other aquatic organisms (e.g., clams) from Cache or Bear Creeks. Incorporating the local angling information into USEPA's criterion, then, Regional Board staff assigned the criterion of 0.3 mg/kg as the average concentration of methylmercury in locally caught trophic level 4 fish. This interpretation still assumes a consumption rate of 17.5 g/day, but accounts for the local situation that most fish consumed are trophic level 4 species.

Although the USEPA fish tissue criterion is applied to trophic level 4 fish in Cache and Bear Creeks, a corresponding safe level in trophic level 3 fish can be calculated using the existing ratio of methylmercury concentrations in large, trophic level 4 and trophic level 3 fish. The existing ratio between methylmercury concentrations in similarly sized trophic level 4 and trophic level 3 fish is 2.0 (See Appendix A: Cache Creek TDML report for current fish data).

$$\frac{\text{Trophic level 4 objective}}{\text{Trophic Level 4/3 ratio}} = \text{trophic level 3 objective}$$

Applying the site-specific trophic level ratio in this equation produces a safe methylmercury level in trophic level 3 fish of 0.15 mg/kg.

$$\frac{0.3\ mg/kg}{2.0} = 0.15\ mg/kg$$

The water quality objectives proposed under Alternative 3 are the following:

0.30 mg methylmercury/kg fish muscle tissue, wet weight in Trophic Level 4 fish,
0.15 mg methylmercury/kg fish muscle tissue, wet weight in Trophic Level 3 fish.

These proposed concentrations are the average methylmercury concentrations in fillet of fish in the range of 150-500 mm total length. For evaluating compliance, assessing the average concentrations in fish from a narrower range of 250-350 mm total length is proposed.

The large fish concentrations of Alternative 3 are not applicable to Harley Gulch. As previously noted, Harley Gulch does not contain TL4 fish or TL3 in a size range consumed by humans or wildlife species seeking large prey. For Alternative 3, then, the objective for Harley Gulch is the same as in Alternative 2 (0.05 mg/kg in small, TL2/3 fish).

4.1.4 Alternative 4. Objectives based on the USEPA's Methylmercury Criterion (0.20 and 0.40 mg/kg, wet weight in Trophic Level 3 and 4 fish, respectively) for Cache and Bear Creeks, Assuming 50%/50% TL3 and TL4 consumption

Alternative 4 proposes water quality objectives for Cache and Bear Creeks using the same methodology as in Alternative 3, with one exception: human consumers of local fish are assumed to eat equal proportions of TL3 and TL4 fish. In comparison, Alternative 3 assumes humans are eating mainly TL4 species.

The CDFG Warden Jimenez stated that bullhead catfish are frequently caught in Cache Creek (CDFG, 2004c). Methylmercury intake by humans eating bullheads (TL4 or 3 fish, depending on species of bullhead and its diet) is expected to be less than intake from eating TL4 species of largemouth bass and channel catfish. Some trophic level 3 species, such as bluegill, may also be caught and kept for consumption. A second option, then, for interpreting the USEPA's criterion is to use 0.3 mg/kg as the overall safe level for a mixed diet of TL3 and TL4 fish. Safe tissue levels for large TL3 and TL4 fish can be calculated as follows.

$0.3 \text{ mg/kg} = (\text{TL3 proportion eaten} * TL3_{conc}) + (\text{TL4 proportion eaten} * TL4_{conc})$

Using the site-specific trophic level ratio to put the TL4 concentration in terms of the TL3 concentration (TLR 4/3 is 2.0), the equation becomes:

$$0.3 \text{ mg/kg} = (\text{TL3 proportion eaten} * TL3_{conc}) + (\text{TL4 proportion eaten} * TLR_{4/3} * TL3_{conc})$$
$$= (0.5 * TL3_{conc}) + (0.5 * 2.0 * TL3_{conc})$$

The water quality objectives proposed under Alternative 4 are the following:

0.2 mg methylmercury/kg fish muscle tissue, wet weight in Trophic Level 3 fish, and
0.4 mg methylmercury/kg fish muscle tissue, wet weight in Trophic Level 4 fish.

These are average concentrations in fish in the size range of 150-500 mm total length. Monitoring in the smaller range of 250-350 mm total length is acceptable.

The large fish concentrations of Alternative 4 are not applicable to Harley Gulch. Therefore, the Alternative 4 objective also contains the same objective for Harley Gulch as in Alternative 2 (0.05 mg/kg in small, TL2/3 fish).

4.2 Evaluation of Water Quality Objective Alternatives

The Water Code Section 13241 identifies six factors that must be addressed when evaluating a water quality objective. Factors to be considered are:

- Past, present and probable future beneficial uses of water;
- Environmental characteristics of the hydrographic unit under consideration; including the quality of water available thereto;

- Water quality conditions that could reasonably be achieved through the coordinated control of all factors that affect water quality in the area;
- Economic considerations;
- The need for developing housing within the region; and
- The need to develop and use recycled water.

The alternatives for water quality objectives are evaluated with respect to these factors in the first six subsections below. The alternatives are also evaluated with respect to applicable State and federal policies

4.2.1 Beneficial Uses

The existing and potential beneficial uses of Cache Creek and its tributaries are listed in Table 3.1. In addition, staff is proposing to add the COMM beneficial use to Cache Creek (including North Fork) and Bear Creek. Three existing beneficial uses, Municipal Supply, Recreation 1 and Wildlife Habitat, are considered impaired due to mercury. The proposed water quality objectives and implementation plan are intended to restore the applicable beneficial uses to Cache Creek. Section 5 of this report presents an implementation plan that, when implemented, is expected to improve water quality conditions and remove the impairments due to mercury.

Each of the proposed alternatives would restore the Municipal Supply and Recreation 1 beneficial uses of Cache and Bear Creeks with respect to mercury levels. Alternative 3 is less protective of the Wildlife Habitat beneficial use than Alternative 1 or 3. Alternatives 1 and 2 protect beneficial uses in Harley Gulch; Alternative 3 has no objective that is applicable to Harley Gulch. Under Alternative 1, beneficial uses are protected by the narrative toxicity objective of the Basin Plan. However, the success of the implementation plan for reducing mercury in these water bodies may best be evaluated against a numeric water quality objective such as those proposed for Alternatives 2 and 3.

4.2.2 Environmental Characteristics of the Hydrographic Unit

The environmental characteristics and existing conditions of Cache Creek and tributaries are discussed in Sections 1 and 3 of this report, respectively. Cache Creek is used for drinking water, irrigation, contact recreation, stock watering, and habitat for warm and cold water aquatic species, including providing for a significant fishery and resources for terrestrial wildlife.

The proposed Basin Plan amendments are designed to improve the water quality of Cache Creek and tributaries by establishing numeric water quality objectives for mercury and defining an implementation plan to meet the objectives. Depending upon the remediation activities selected by the responsible parties, there may be temporary, localized adverse impacts on water quality of the water bodies during implementation. Possible effects of these types of activities, such as mine remediation, are discussed in Section 7. All of the proposed water quality objective alternatives would result in improvements to water quality of Cache Creek and tributaries. Levels of improvement that would likely be reached are described in the next section.

4.2.3 Water Quality Conditions That Could Reasonably Be Achieved

The Basin Plan narrative toxicity objective (Alternative 1, No Action) describes the water quality conditions that should exist in Cache Creek and tributaries. In order to prepare an implementation plan to achieve these conditions, the narrative objective is translated into a numeric objective. Water quality conditions expected under Alternatives 2 and 3, which interpret the narrative objective, are discussed below.

Meeting the Alternative 2 proposed water quality objectives would fully protect wildlife and allow people to safely eat a moderate amount of fish from Cache Creek. Under Alternative 2, consumers may safely eat up to 22 g/day of local fish (3 meals/month). This consumption rate assumes that most of the fish eaten will be trophic level 4 species. If consumers ate only trophic level 3 species, the safe intake rate would be around 29 g/day (4 meals/month). If consumers eat no commercial fish, the safe intake of Cache Creek fish can be slightly higher (an added 8 to 10 g/day, depending upon relative concentrations of mercury in local and commercial fish)[6]. These are safe consumption levels for all adults eating fish from Cache Creek, including pregnant and nursing women. Children of any age could safely eat at these consumption rates when the meal size is adjusted to the child's body weight (OEHHA, 1999)[7].

To attain the objectives in Alternative 2, aqueous methylmercury concentrations in Cache Creek would have to be reduced between 20-86% of existing conditions. Aqueous methylmercury concentrations in Bear Creek and Harley would need to be reduced by 85%. This reduction proposal is described in Sections 5.1, 5.5, and the TMDL Report (Appendix A). Section 5.9 discusses an implementation program that will be a combination of controlling methylmercury sources and sources of total mercury discharged to "methylization hotspots", reducing total mercury loads to tributaries, reducing mercury sediment concentrations, and erosion control. Estimated time for compliance with the proposed objectives is discussed in Section 5.10. Attainment of proposed objectives in Cache Creek could take several hundred years, assuming that new inputs of mercury are significantly reduced. Concentrations of methylmercury in water are expected decrease as sediment mercury concentrations decline.

The Alternative 3 objectives are slightly less protective of humans and wildlife species than those in Alternative 2. The safe intake levels recommended by the USFWS for bald eagle could be exceeded under the Alternative 3 objectives. Humans could safely eat fish from Cache or Bear Creeks up to 17.5 g/day (2.3 meals/month). As for Alternative 2, children could safely eat local fish at this rate if portion sizes are sizes relative to their smaller body weight. Although the Alternative 3 proposed fish tissue objectives are higher, the control program needed to achieve the objectives would be essentially the same for Alternatives 2 and 3. This is because the core of the implementation plan, which is to reduce inputs from the most concentrated sources of mercury in the upper watershed (including mines) while keeping conditions from worsening in the lower watershed, is necessary for any improvements to occur. Time to attain the fish tissue objectives would likely be less than Alternative 2.

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[6] The estimated average concentration of methylmercury in commercial fish and shellfish, weighted by proportions of the types consumed, is 0.157 mg/kg (USEPA, 2001). Mercury levels in most fish sampled from Cache and Bear Creeks are higher than this average.

[7] The portion size for an average adult weighing 155 pounds of is assumed to be 8 ounces of fish (uncooked) A table relating body weight to portion size is available from the Office of Environmental Health Hazard Assessment (OEHHA, 1999).

The Alternative 4 objectives are the highest fish tissue concentrations proposed. If these objectives were attained, the estimated overall concentration of methylmercury in prey is substantially higher than that safe diet concentration calculated for Alternative 2 (0.34 versus 0.195 mg/kg in tissue of all prey combined; See TMDL report). For humans, the Alternative 4 objectives are sufficient as long as people consume approximately equal parts of TL3 and TL4 fish. People eating mainly TL4 fish from Cache or Beard creeks would not be protected.

The goals of all of the proposed water quality objectives and the control program are to return mercury levels in fish tissue to levels that occurred in the pre-mining period and to remediate mercury sources contributing to the mercury impairment. Regional Water Board staff considered providing the pre-mining condition as an alternative, but was unable to determine the pre-mining fish tissue concentrations of methylmercury. The proposed tissue and sediment concentrations are expected to result in fish tissue concentrations that would approach a natural background level.

The Cache Creek watershed is naturally very erosive; with some regions containing elevated concentrations of mercury while other regions have low or 'diluting' levels of mercury in the soil. Once the mercury hotspots are remediated, erosion of soils with less mercury will act to decrease the overall mercury concentration in creek bed sediments. This natural erosion process in the watershed may improve water quality conditions beyond the site-specific water quality objectives proposed for Alternatives 2 and 3. The implementation alternatives (Section 5) proposed to meet proposed water quality objectives depend upon a combination of active remediation and passive burial of mercury containing sediments sediment with clean sediment from the tributaries. Although remediation activities will be designed to achieve a particular level of cleanup, passive burial is expected to continue indefinitely and may reduce sediment and fish tissue concentrations beyond the remediation goals and corresponding fish tissue concentrations. If mercury levels in the fish fall below the recommended water quality objectives, the Basin Plan objectives may be amended again to reflect the improved water quality conditions and to prevent degradation.

4.2.4 Economic Considerations

Section 3.3 describes the existing sport fishery in Cache and Bear Creeks. It is difficult to estimate the economic value of the Cache Creek watershed fishery. The CDFG warden for the watershed estimated that most people angling there are local or county residents (CDFG, 2004c). Local fish may be an important protein source for a portion of the angling population in this largely rural/agricultural area. The California Office of Environmental Health Hazard Assessment recently issued a fish consumption advisory for Cache and Bear Creeks. Although angling may decrease in the near term due to publication of the advisory, use of Cache Creek watershed fish as a food resource would presumably increase as methylmercury levels decline.

4.2.5 Need for Housing

None of the proposed water quality objectives would restrict the development of housing in the Cache Creek watershed.

4.2.6 Need to Develop and Use Recycled Water

There are no present restrictions on recycling of water due to mercury. The intent of this proposed amendment is to improve water quality and reduce mercury levels in Cache Creek. The proposed objectives, therefore, are consistent with the need to develop and use recycled water. None of the alternatives considered would restrict the development or use of recycled water.

4.2.7 Consistency with Federal and State Laws and Policies

Federal and State agencies have adopted water quality control policies and water quality control plans to which Regional Water Board actions must conform. The following section describes each of the policies that are applicable to the proposed Basin Plan amendments. It also discusses applicable Regional Water Board policies that are contained in the Basin Plan.

4.2.7.1 Endangered Species Act

Wildlife species most likely to be adversely affected by mercury are upper trophic level species that feed mainly on fish, such as otter, grebe, merganser, and bald eagle. The bald eagle is listed as threatened by the federal level. The Cache Creek watershed hosts a large wintering population of bald eagles. Wintering bald eagles feeding in Cache and Bear Creeks are frequently observed to consume large, non-game fish species (USBLM, 2002; Slotton *et al*., 2004). Nesting by bald eagles in the Cache canyon has been observed since 2000 (USBLM, 2002). No other piscivorous birds that occur in the Cache Creek watershed is categorized as threatened or endangered on the federal list. On the State of California endangered and threatened species list, the bald eagle is the only species that is of concern for mercury contamination due to feeding on aquatic organisms from Cache Creek and/or Bear Creeks. Because of the lack of suitable prey, bald eagles are not expected to forage in the Harley Gulch and Sulphur Creek drainages. Peregrine falcons (listed by the State as endangered) have been observed while foraging, but are not known to nest in the Cache Creek watershed (Linthicum, 2003; USBLM, 2002).

Alternatives 2 water quality objectives are expected to be fully protective of wildlife species described above. Alternative 2 objectives were developed with guidance from the USFWS and are fish tissue concentrations derived specifically to protect bald eagles, kingfishers, river otters, and other wildlife feeding in the Cache Creek watershed. Objectives in Alternatives 3 and 4are higher than in Alternative 2 and thus less protective of bald eagles.

The purpose of the Basin Plan amendments is to restore the beneficial uses that are not currently being met, including wildlife habitat. The implementation plan is designed to improve the water quality of the Cache Creek watershed with respect to mercury concentrations. The proposed Basin Plan amendments are not expected to adversely affect endangered species. Habitat for endangered species and other wildlife is expected to be improved by the water quality objectives and implementation program.

4.2.7.2 Antidegradation

The Federal Antidegradation policy (from 40 CFR 131.12) is:

(a) The State shall develop and adopt a statewide antidegradation policy and identify the methods for implementing such policy pursuant to this subpart. The antidegradation policy and implementation methods shall, at a minimum, be consistent with the following:

(1) Existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.

(2) Where the quality of the waters exceed levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water, that quality shall be maintained and protected unless the State finds, after full satisfaction of the intergovernmental coordination and public participation provisions of the State's continuing planning process, that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. In allowing such degradation or lower water quality, the State shall assure water quality adequate to protect existing uses fully. Further, the State shall assure that there shall be achieved the highest statutory and regulatory requirements for all new and existing point sources and all cost-effective and reasonable best management practices for nonpoint source control.

(3) Where high quality waters constitute an outstanding National resource, such as waters of National and State parks and wildlife refuges and waters of exceptional recreational or ecological significance, that water quality shall be maintained and protected.

(4) In those cases where potential water quality impairment associated with a thermal discharge is involved, the antidegradation policy and implementing method shall be consistent with section 316 of the Act

.

The proposed Basin Plan amendments would establish the first numeric water quality objectives for mercury in Cache Creek, Bear Creek, and Harley Gulch to fully protect and maintain their respective beneficial uses. The implementation plan is designed to improve, not reduce, water quality in the Cache Creek watershed.

4.2.7.3 State Water Board Policies[8]

The State Policy for Water Quality Control

This policy is the basis for the State Water Board to protect water quality through the implementation of water resources management programs. The proposed Basin Plan amendments are consistent with this policy in that it provides an implementation plan to reduce the level of methylmercury and mercury in the Cache Creek watershed. The implementation plan is discussed in Section 5.

State Water Board Resolution No. 68-16, Statement of Policy with Respect to Maintaining High Quality of Water in California

State Water Board Resolution No. 68-16, Statement of Policy with Respect to Maintaining High Quality of Water in California, is summarized on page IV-8.00 of the Basin Plan as follows:

[8] State Water Resources Control Board plans and policies are available at: http://www.waterboards.ca.gov/plnspols/index.html

The State Water Board adopted this policy on 28 October 1968. The policy generally restricts the Regional Water Board and dischargers from reducing the water quality of surface or ground waters even though such a reduction in water quality might still allow the protection of the beneficial uses associated with the water prior to the quality reduction. The goal of the policy is to maintain high quality waters.

Changes in water quality are allowed only if the change is consistent with maximum benefit to the people of the State; does not unreasonably affect present and anticipated beneficial uses; and, does not result in water quality less than that prescribed in water quality control plans or policies. USEPA water quality standards regulations require each state to adopt an "antidegradation" policy and specify the minimum requirements for the policy (40 CFR 131.12). Resolution No. 68-16 preceded the federal policy and applies to both ground and surface waters. The State Water Board has interpreted State Water Board Resolution No. 68-16 to incorporate the federal antidegradation policy. Therefore, the federal antidegradation policy must be followed where it is applicable. The federal antidegradation policy applies if a discharge or other activity, which began after 28 November 1975, will lower surface water quality. Application of the federal policy may be triggered by water quality impacts or mass loading impacts to receiving waters. Resolution No. 68-16 is Appendix Item 2; the federal policy is Appendix Item 39.

The proposed Basin Plan amendments establish water quality objectives for mercury in fish. The proposed objective is designed to be protective of wildlife, including threatened and endangered species that consume fish or other wildlife from Cache Creek and tributaries. The proposed amendments also protect humans that consume fish from Cache and Bear Creeks. The proposed Basin Plan amendments are intended to improve water quality and do not result in lower water quality than is prescribed in other plans or policies.

State Water Board Resolution No. 88-63, Sources of Drinking Water Policy
This policy states that all waters of the State are to be protected as existing or potential sources of municipal and domestic supply water. The proposed Basin Plan amendments are consistent with this policy. In the Basin Plan, Cache Creek has already been assigned the beneficial uses of municipal, domestic supply, and agriculture. Although water from the Cache Creek watersheds contributes to drinking water sources downstream of the Yolo Bypass, there are no current uses of drinking water taken directly from Cache, Bear, or Sulphur Creeks or Harley Gulch. The proposed water quality objectives and implementation plan will further reduce mercury levels in drinking water.

State Water Board Resolution No. 90-67, Pollutant Policy Document
The Pollutant Policy Document requires, in part, that the Regional Water Board develop a mass emission strategy for limiting loads of heavy metals, among other pollutants, from entering the Delta. Because water from Cache Creek, flows into the Yolo Bypass and then into the Delta, this policy applies to Cache Creek. The Cache Creek, Bear Creek, and Harley Gulch TMDL report, the Sulphur Creek TMDL report, and the proposed amendments establish a plan for limiting the load (total mass) of mercury (a heavy metal) from entering Cache Creek and it tributaries and eventually the Delta. Therefore, the proposed amendments are consistent with this policy.

State Water Board Resolution No. 92-49, Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code Section 13304

This resolution contains policies and procedures for Regional Water Board to follow for oversight of cleanup projects to ensure cleanup and abatement activities protect the high quality of surface and groundwater. In order to attain the proposed water quality objective, the proposed Basin Plan amendments provide an implementation plan to reduce methylmercury and mercury loadings into Cache Creek and tributaries. The proposed plan requires mercury discharges from the numerous inactive mercury mines be minimized and for mercury sources to tributaries to be evaluated, monitored, and controlled. Resolution No. 92-49 is relevant and applicable to mercury mine cleanup activities in the Cache Creek watershed.

Nonpoint Source Pollution Control Program
The Nonpoint Source (NPS) Pollution Control Program is a statewide, coordinated effort to address nonpoint sources of pollution through the implementation of management practices. The NPS Implementation Plan describes the activities that state agencies - including State and Regional Boards - are taking to reduce NPS pollution. The Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program describes the tools that the SWRCB and the RWQCBs have at their disposal to implement the NPS Program. These are planning authority, administrative permitting authority (waste discharge requirements [WDRs], waivers of WDRs, and Basin Plan prohibitions), and enforcement options. The Cache Creek mercury control Bay-Delta TMDL makes use of these tools, where applicable, to control NPS sources of mercury and therefore is consistent with this policy.

The proposed Basin Plan amendments include an implementation plan (see Section 5) to reduce mercury discharges from both mines and nonpoint sources within the Cache Creek watershed. Section 5 discusses the development and implementation of monitoring and control programs reduce methylmercury and mercury sources hot spots through implementation of management practices and regulatory-based approaches for landowners and local, state, and federal agencies. Remediation of inactive mercury mine sites and management practices to control erosion of sediments containing mercury will be the most likely methods to reduce the transport of soils containing mercury into Cache Creek and tributaries.

4.2.7.4 Regional Water Board Policies

Urban Runoff
This policy requires subregional municipal and industrial plans to assess the impact of urban runoff on receiving water quality and to consider abatement measures if problems exist. While there are no known sources of mercury from municipal and industrial runoff in Cache Creek, the proposed Basin Plan amendments require the local, State, and federal agencies to assess their jurisdictional land for mercury sources and to develop reduction plans if necessary.

Controllable Factors Policy
This policy requires controllable water quality factors be managed to prevent further degradation of water quality where objectives have been exceeded. Currently, the proposed methylmercury water quality objectives are being exceeded in Cache Creek and tributaries. The proposed Basin Plan amendments include an implementation plan to control mercury discharges from the mercury mine sites, tributaries, and sediments with mercury that are contributing to methylmercury production. Compliance with the Basin Plan amendments will prevent further degradation and improve water quality and is consistent with this policy.

The Water Quality Limited Segment Policy
This policy requires additional treatment beyond minimum federal requirements on discharges to Water Quality Limited Segments. The policy states that dischargers will be allocated a maximum allowable load of critical pollutants so that water quality objectives can be met in the segment. The TMDL for mercury in Cache, Bear, and Sulphur Creeks and Harley Gulch establishes the total maximum load that can be applied to these waters and still meet beneficial uses. The TMDL determined the load reductions required from each source and allocated those loads to the point and nonpoint sources Cache Creek and tributary watersheds. The proposed Basin Plan amendments assign load reductions to the mercury sources to meet proposed water quality objectives and is consistent with this policy.

Antidegradation Implementation Policy
This policy requires the Regional Water Board to apply and implement State Water Board Resolution No. 68-16 when regulating discharges of pollutants. The Regional Water Board policy requires an assessment of the discharge that could affect waters of the State and to apply methods of best practicable treatment or control to maintain high quality water. As noted above, the proposed Basin Plan amendments include water quality objectives and an implementation plan to improve water quality and reduce mercury levels in fish tissue and sediment. The plan requires load reductions from the various mercury sources. The load reduction program may be accomplished through treatment and control measures designed to minimize or prevent release of mercury from sources. The proposed amendments are consistent with this State Board policy.

Policy for Application of Water Quality Objectives
This policy in part defines water quality objectives, specifies that objectives may be narrative or numeric, and indicates that the objectives apply to all waters for which beneficial uses have been defined. The policy also discusses mixing zones and the use of NPDES permits to establish effluent limits and time schedules for compliance. It also requires the Regional Water Board to adopt numeric objectives on a site-specific basis for constituents where compliance with narrative objectives is required. The proposed numeric objectives in this Basin Plan amendment are specific to surface waters in Cache Creek and tributaries and will be used to determine compliance with the narrative standard. The proposed Basin Plan amendments propose to establish, as necessary, a combination of NPDES permits, cleanup orders, or enforcement orders to control for the sources of mercury (See Section 5). Regulatory permits or orders will have appropriate requirements to comply with the proposed objectives and time schedules for compliance. The proposed implementation plan will provide a time schedule for the local, State, and federal agencies to develop and submit to the Regional Board plans for methylmercury and sediment management.

This policy states that the numeric water quality objectives must protect beneficial uses; however, the water quality objectives do not require improvement over naturally occurring background concentrations. As discussed in this report, the Cache Creek watershed is naturally enriched in mercury. Recent studies by Churchill and Clinkenbeard (2004) and others (Pearcy and Petersen, 1990) and Regional Board staff have documented elevated mercury concentrations adjacent to mine sites (undisturbed areas) and distant from the mine sites. However, the most severe mercury concentrations are adjacent to and downstream of the mercury mines. Mining activities have greatly increased mercury concentrations in streambed sediment in Cache Creek, the Yolo bypass, and the Delta. While the background concentrations of mercury in fish tissue prior to mining activities are unknown, they are expected to be less than present

concentrations. Pre-mining conditions in Cache Creek may have been similar to those in North Fork Cache Creek, which has low sediment mercury and fish tissue concentrations similar to proposed objectives. The proposed implementation plan will minimize mercury inputs from the mercury mines and reduce Cache Creek and tributary methylmercury loading; in the long term, these actions should lower mercury concentrations in sediment and fish tissue to premining or background levels.

4.2.8 Sulphur Creek MUN Beneficial Use

Sulphur Creek is a tributary stream of Cache Creek. Sulphur Creek is not listed in Table II-1 of the Basin Plan. For tributary streams that are not listed in Table II-1, the Basin Plan states that "the beneficial uses of any specifically identified water body generally apply to its tributary streams." The Basin Plan designates uses for Cache Creek that include, among others, municipal and domestic supply (MUN). Under the Basin Plan's tributary streams language, MUN is assigned to Sulphur Creek. Because Sulphur Creek is not listed in Table II-1, the Basin Plan provision implementing State Board Resolution No. 88-63 (Sources of Drinking Water Policy) also separately assigns MUN to Sulphur Creek.

The MUN beneficial use is not present in Sulphur Creek. Regional Board staff is unaware of any direct municipal and domestic supply use of water from Sulphur Creek. Sulphur Creek flows to Bear Creek, which flows to Cache Creek. Cache Creek is designated for municipal and domestic supply. However, water from Sulphur Creek is well diluted in Cache Creek. Sulphur Creek provides less than one percent of the flow volume in Cache Creek (CVRWQCB, 2004).

Water quality in Sulphur Creek is a function of inputs from the geothermal springs and erosion of naturally mercury-enriched soil. Naturally occurring mercury, total dissolved solids, electrical conductivity in geothermal water in Sulphur Creek exceed existing criteria. Geothermal springs are present in the creek bed. The Sulphur Creek TMDL report provides data that demonstrate the CTR mercury criterion of 50 ng/l of total recoverable mercury is exceeded on a regular basis[9]. At the USGS gauge near the mouth of Sulphur Creek, the mean mercury concentration is over 2,900 ng/l with a range 303-16,411 ng/l total recoverable mercury (Foe and Croyle, 1998; Domagalski *et al*., 2004; Suchanek *et al.*, 2004; data collected in 2003-2004 by CVRWQCB for the Sulphur Creek TMDL). Upstream of the majority of the mercury mines, the mean mercury concentration was 1,389 ng/l during winter flows (range 330-3,422 ng/l; Suchanek *et al.*, 2004 and CVRWQCB data). There is no surface flow in Sulphur Creek upstream of West End mine and there are no surface water discharges from the mine sites in the summer; therefore summer creek flows are entirely geothermal and spring flows.

Thermal springs in the watershed have mercury concentrations that range from 10,000 to 33,600 ng/l. (Goff *et al.*, 2001; Rytuba, 2000; Suchanek *et al*, 2004; CVRWQCB data). In winter, discharges from the springs are diluted by runoff from rain events. In periods of no precipitation, mercury concentrations in creek water are less than at the spring inputs for two reasons: 1) dilution by surface or subsurface flows, and 2) precipitation of mercury after leaving the spring outlets.

[9] Water quality data are typically compared with the criterion using a 30-day averaging interval with and allowable exceedance frequency of once every three years. Although Sulphur Creek data were not collected repeatedly during 30-day intervals, the water chemistry is sufficiently consistent to assume that the CTR criterion for mercury is exceeded.

Water in Sulphur Creek exceeds federal and state standards for total dissolved solids (TDS) and conductivity drinking water. Exceedances are greatest in the dry season, when springs comprise most of the water flow in Sulphur Creek. The secondary maximum contaminant level for TDS in drinking water is 500 mg/L. At noted above, the criteria in Resolution 88-63 for excepting the MUN beneficial use is waters where the TDS exceeds 3,000 mg/l. Sulphur Creek contains TDS of 7,270-17,770 mg/L. TDS concentrations measured at spring outflows were 24,943-33,024 mg/L (Goff *et al.*, 2001).

The USEPA and California public heath goal (secondary) for conductivity is 900 µmhos/cm. The criteria in Resolution 88-63 for excepting the MUN beneficial use is waters where the EC exceeds 5,000 µS/cm. Electrical conductivity in Sulphur Creek was 11,360-36,700 µmhos/cm in the dry season (Goff *et al.*, 2001) and 299-1,974 µmhos/cm following winter storms (CVRWQCB, 2004; Suchanek *et al*., 2004). Conductivities of spring outflows range from 31,900-44,930 µmhos/cm (Goff *et al*., 2001; Suchanek *et al*., 2004).

Sulphur Creek water exceeds the drinking water criteria for constituents of mercury, TDS, and electrical conductivity. The State Board Sources of Drinking Water Policy sets limits that allow an exception for designation as a drinking water source. Levels of TDS and electrical conductivity in Sulphur Creek are greater than these limits. High electrical conductivity and TDS levels derive from naturally occurring springs that discharge to the creek. In low-flow periods, the springs also provide mercury in excess of the California Toxics Rule criterion. As discussed in the next chapter, Regional Board staff proposes to require cleanup of the mine sites and anthropogenic sources of mercury entering Sulphur Creek. Regional Board staff will be working on a report which may recommend that the Board adopt a Basin Plan Amendment to modify the beneficial use of municipal and domestic supply and propose criteria that are reflective of naturally occurring mercury, TDS, and electrical conductivity and protective of other beneficial uses of Sulphur Creek.

4.3 Recommended Alternative

Regional Water Board staff recommends adoption of Water Quality Objective Alternative 2. This alternative would establish Cache Creek and Bear Creek objectives of 0.12 mg/kg and 0.23 mg/kg methylmercury in wet weight fish tissue, as the average concentration in large fish of trophic levels 3 and 4, respectively, and the Harley Gulch objective 0.05 mg methylmercury /kg, wet weight, for trophic level 2and 3 fish in the range 75-100 mm total length. These objectives were derived to be protective of wildlife in the Cache Creek watershed including bald eagles, osprey, and peregrine falcon. These proposed objectives would allow humans to safely consume 22-29 gm/day (depending on Cache Creek species consumed and assuming the consumers eat the national average of 12.5 g/day of commercial fish) of Cache Creek fish. The recommended objectives protect a slightly higher proportion of the fish-consuming population than would be protected by Alternatives 3, which is based on USEPA's default consumption rate for the general population.

Alternative 1 (No Action; defaulting to the existing narrative toxicity objective) is not recommended by Regional Water Board staff for two reasons. First, the USFWS and U.S. National Marine Fisheries Service are concerned that the USEPA's mercury criterion in the CTR would not be sufficiently protective of threatened and endangered species. In addition, Regional Water Board staff is concerned that the CTR criterion is not sufficiently protective of humans that consume fish from Cache Creek. The CTR water column criterion was derived using the same factors as the fish tissue alternatives, with an

additional factor to relate fish tissue concentrations to water concentrations. This additional factor, termed the practical bioconcentration factor, is the ratio of mercury concentrations in fish and water. The practical bioconcentration factor used for the CTR criterion is 7342.6 (USEPA, 2000a). In comparison, ratios of mercury in fish to water at Cache Creek are higher. Ratios of mercury in fish to total mercury in water in Cache Creek were 27,000-40,000 for largemouth bass. Use of the higher ratios would result in a lower water column criterion to protect humans consuming fish from Cache Creek.

Regional Board staff is not recommending Alternative 3 (based on the USEPA's Recommended Water Quality Criterion for Methylmercury for the Protection of Human Health; 0.15 and 0.3 mg/kg, wet weight in large, trophic level 3 and 4 fish, respectively, for Cache and Bear Creeks) because it is not fully protective of wildlife. The 0.3 mg/kg level in TL4 fish is higher than the level estimated to fully protect bald eagle, osprey and possibly river otter from adverse effects of mercury. The USFWS has provided comment to the Regional Board (2004) that 0.3 mg/kg in trophic level 4 fish would not be protective of local wildlife species. Site-specific consumption patterns or information on species' sensitivities to mercury are not available for the Cache Creek watershed. Therefore, the USFWS based their risk assessment on a standard, literature values for average consumption by these wildlife species and a careful review of bald eagle diet in other parts of California and elsewhere (USEPA, 1995a and 1997; USFWS, 2002; 2003; 2004). Although site-specific consumption information would be preferred, the use of average consumption patterns, sensitivities and body weight data is widely accepted for establishing water quality criteria for mercury and other pollutants, to protect humans and wildlife.

Alternative 4 is not recommended by Staff for two reasons. First, Alternative 4 is not fully protective of bald eagles and other wildlife consuming large fish. Second, this alternative is less protective of humans consuming TL4 fish species than Alternatives 2 or 3. Bass and channel catfish are two of the top three types of fish caught in Cache Creek (CDFG, 2004). Humans eating these TL4 fish would have to maintain their consumption at less than one meal every two weeks (USEPA default consumption rate).

The ultimate goal of mercury control in the Cache Creek watershed is to reduce levels in fish to protect humans and wildlife that consume fish and to reduce the export of sediments containing mercury to the Delta. As described in the proposed implementation plan described in Section 5, staff expects that sediment concentrations will decrease once the addition of highly concentrated sediments from the mine sites is minimized. Through the application of best management practices to control erosion of sediments containing mercury, mercury mine remediation, and restoration or stabilization of creek segments containing elevated mercury levels, fish tissue concentrations will decrease to at or below the proposed objectives to a background or premining level. However, the ultimate aqueous methylmercury goals and the length of time needed to reach them are uncertain. The staff recommendation is adopt Alternative 2 to establish objectives to protect the beneficial uses of Cache and Bear Creeks and Harley Gulch and to require that abatement activities be implemented that would result in methylmercury load reductions that would, over the long term, result in mercury fish tissue levels that would approach historical background levels and reduce total mercury loads to the Delta.

4.4 Application of Recommended Alternative to the Basin Plan

The recommended alternative would add new site-specific water quality objectives to Chapter 3 of the Basin Plan. Adoption of the proposed change would establish water quality objectives for methylmercury

in fish of trophic levels 3 and 4 for Cache and Bear Creeks and in trophic levels 2 and 3 for Harley Gulch. To facilitate evaluating compliance with the proposed objectives, proposals to amend Chapter 5 of the Basin Plan (Surveillance and Monitoring) include a monitoring program that specifies fish species and sizes within each trophic level. The fish species and sizes used to develop the objectives were derived from sizes of fish locally caught in various sampling programs, and from the life history and prey types of the various species of fish (McGinnis, 1984; Wang, 1986; Moyle, 2004) and piscivorous wildlife (Hamas, 1994; USEPA, 1995a; USEPA, 1997; USFWS, 2002). The Regional Water Board will act as the lead agency in developing or reviewing detailed monitoring plans and resources to evaluate compliance with the proposed water quality objectives.

Currently, only non-point sources of mercury exist in the water bodies for which these fish tissue objectives apply. If in the future, it is found that point sources exist, implementation guidance will be necessary for reasonable potential determinations and for developing water quality-based effluent limitations. At that time, implementation guidance for point sources will be developed. The relationship between methylmercury in fish tissue and aqueous (unfiltered) methylmercury in the water column is the basis for the load allocations (for non-point sources) in the Section 5.2 and the TMDL report. This relationship may be used as the basis of any future waste load allocations for point sources, as well as the basis for future implementation guidance.

5 PROGRAM OF IMPLEMENTATION

The proposed water quality objectives for methylmercury in Cache Creek, Bear Creek, and Harley Gulch are being exceeded. In addition, the proposed sediment goals for Sulphur Creek are being exceeded. The Regional Water Board must therefore develop an implementation plan to bring the Cache Creek watershed into compliance with the proposed objectives and sediment goals in order to protect beneficial uses. Water Code Section 13242 prescribes the necessary contents of an implementation plan, which include: 1) a description of the nature of the actions that are necessary to achieve the water quality objectives; 2) a time schedule; and 3) a monitoring and surveillance program.

Section 5 describes a program of implementation to achieve the water quality objectives and mine cleanup goals. This section includes an evaluation of alternative programs of implementation and staff's recommendation of an implementation alternative. Also included are estimated costs for the alternatives. The surveillance and monitoring program is described in Section 6 of this report.

The implementation plan must ensure that all applicable water quality criteria will be attained and maintained. The applicable water quality criteria consist of: 1) the California Toxics Rule 50 µg/l total recoverable total mercury water column criterion for the protection of human health; and 2) the proposed site-specific methylmercury fish tissue objectives for the protection of wildlife and human health. The TMDL allocations are in the form of aqueous (unfiltered) methylmercury in the water column and are specifically correlated and set to attain and maintain the proposed fish tissue methylmercury objectives. However, the proposed implementation actions included in this chapter are designed to reduce the amount of total mercury into the water bodies, in order to ensure attainment and maintenance of both the total recoverable water column criterion, as well as the methylmercury fish tissue objectives, by reducing the total amount of mercury available for methylation.

The focus of the implementation plan for Cache and Bear Creeks and Harley Gulch is to reduce methylmercury and total mercury discharges to the Cache Creek watershed. The mercury reduction plan will be accomplished through a three-part process:

1). Reduce loads of total mercury entering the watershed by controlling discharges and erosion from the Abbott and Turkey Run mercury mines and from mines in the Bear Creek watershed;
2). Determine sources of methylmercury production and develop plans to reduce methylmercury loads; and
3). Control discharges of sediments in erosive watersheds where the total mercury sediment concentrations are greater than 0.2 mg/kg, dry weight.

An important component of this program is to reduce loads of total mercury into aquatic environments that generate methylmercury and reduce concentrations of mercury in streambeds and banks.

For Sulphur Creek, the goals of the implementation plan are to reduce the mercury concentration in sediment within Sulphur Creek thereby reducing the overall loading of total mercury and methylmercury to Bear and Cache Creeks. To achieve these goals, staff proposes a program that includes these major components:

1) Reduce total mercury discharges from the mercury mine sites in the Sulphur Creek watershed;

2) Reduce the concentration of mercury in Sulphur Creek sediment adjacent to and downstream of the mercury mines;
3) Control erosion of sediments in within the Sulphur Creek watershed where the total mercury sediment concentrations are greater than 0.2 mg/kg, dry weight; and
4) Evaluate the feasibility of controlling mercury loads from geothermal springs.

The TMDL implementation programs require remediation of inactive mercury mines to limit output of mercury. After mine remediation, the next step would be to remediate the streambeds to reduce mercury in sediment and reduce methylmercury production where feasible. Alternatives that may be considered to address mercury in streambeds include erosion control, stream bank stabilization, sediment removal, and allowing sediment with low concentrations of mercury to replace or bury sediments containing greater concentrations of mercury in the streambed. The implementation alternatives described in Section 5.10 contain varying degrees of intensity of active remediation. The proposed implementation plan, in part, depends also upon natural erosional processes to remove sediments containing mercury that are already deposited in creek beds and banks. The natural erosional processes are expected to take many decades to return creek banks and beds to pre-mining concentrations. Following active remediation such as at mine sites, relatively rapid improvements in methylmercury levels are expected in close proximity downstream of the sites. More gradual and protracted declines in methylmercury concentrations are expected during the period of natural erosion.

All of the alternatives for water quality objectives described in Chapter 4 require mercury and methylmercury reductions from existing conditions. For any of the objectives selected, Staff's basic strategy of reducing total mercury loads in the upper Cache Creek watershed (including impaired tributaries) while preventing an increase in inputs in the lower watershed, would not change. Depending upon the water quality objectives selected, the Board may change details of specific projects or time schedules. Less stringent water quality objectives would require less overall time to compliance than more stringent objectives. Because of the long period required for natural erosion of significant sources of mercury in the creek beds and banks, the ultimate time to compliance with the selected water quality objective may differ little between the several possibilities for the objectives.

5.1 Aqueous Methylmercury Goals

The Cache Creek, Bear Creek, Harley Gulch, and Sulphur Creek TMDL reports (Appendices A and B) contain detailed discussions of methylmercury and mercury sources, the linkage between loads of mercury and methylmercury in fish tissue, sediment goals, and the load reductions from the sources and tributaries needed to meet the proposed water quality objectives. In the Cache Creek watershed, statistically significant, positive relationships exist between concentrations of methylmercury in water and various trophic levels of the aquatic food chain (Slotton *et al.*, 2004).

The relationship between methylmercury concentrations in water and large trophic level 3 and 4 fish in Cache Creek are presented in Figures 5.1 and 5.2. Regional Board staff recommends water quality objectives for large trophic level 3 and 4 fish in Cache and Bear Creeks of 0.12 and 0.23 mg/kg mercury, respectively. Using the regressions below, staff determined concentrations of methylmercury in water (unfiltered) that correspond to the proposed objectives. These concentrations are 0.15 ng/L for the TL3 tissue objective and 0.14 ng/L for the TL4 objective. To ensure meeting both fish tissue objectives, Regional Board staff selected the lower of the two values as the aqueous methylmercury goal for Cache

Creek. Should the Board elect to adopt alternate objectives, the figures may then be used to calculate the corresponding water quality goals. Some of the aqueous goals calculated from Figures 5.1 and 5.2 may be higher than those previously recommended in the TMDL report for Cache Creek, which were developed using relationships between water and invertebrates.

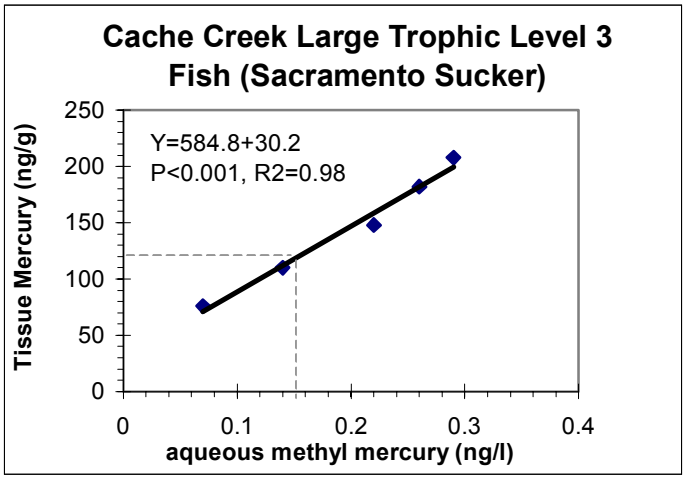

Figure 5.1. Large Sacramento Sucker versus Aqueous, Unfiltered Methylmercury. Fish tissue mercury normalized to 290 mm. From Slotton et al., 2004.

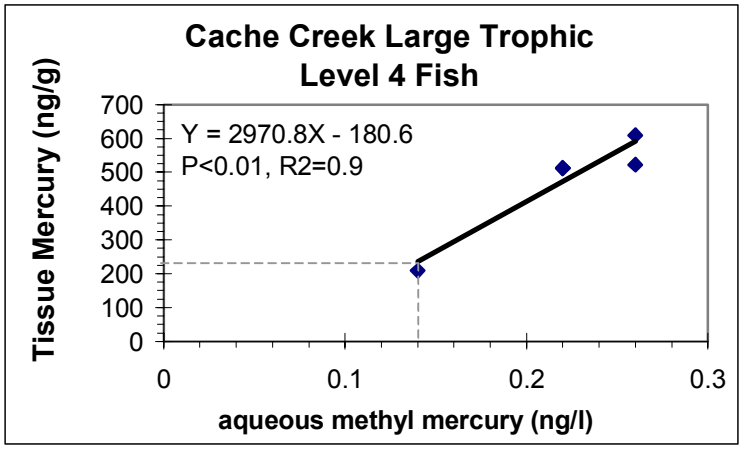

Figure 5.2. Large Trophic Level 4 Fish versus Aqueous, Unfiltered Methylmercury. Points represent concentrations in combination of TL4 species (largemouth bass, small mouth bass, and pikeminnow, depending upon site), normalized to 305 mm. Fish data from Slotton et al., 2004.

The aqueous methylmercury goal for Bea r Creek 0.06 ng/L is unchanged from the TMDL report. The TMDL report described two calculations of aqueous goals for Bear Creek. The original TMDL linkage for Cache Creek included data for upper Bear Creek, but not for lower Bear Creek, where fish tissue concentrations are much higher than main stem Cache Creek. This original linkage produced an aqueous methylmercury goal of 0.06 ng/L. For lower Bear Creek, staff used the ratio of fish tissue to water to calculate water methylmercury levels of 0.025 to 0.045 ng/L (median and average water concentrations) that correspond to the fish tissue targets. Due concerns over accurate detection of methylmercury concentrations of 0.04 ng/L or lower, staff applied the upper Bear Creek aqueous goal to the entire Bear Creek. Substantial reductions in methylmercury concentrations must be made to achieve a goal of

0.06 ng/L. Regional Board staff is continuing to collect methylmercury data in Bear Creek. The aqueous goal may be refined as part of the periodic review of this Basin Plan Amendment.

The aqueous methylmercury goal for Harley Gulch is also the same as described in the TMDL report. The relationship between methylmercury concentrations in small, trophic level 2/3 fish and in water in Harley Gulch was used to develop an aqueous methylmercury goal specific to Harley Gulch of 0.09 ng/L.

The aqueous goals represent the annual, average concentration of total (unfiltered) methylmercury. The aqueous methylmercury goals provide the basis for the allocations shown in the draft Basin Plan Amendment and detailed in the TMDL reports. The goals are intended to be used to track progress in meeting the water quality objectives in fish tissue. The methylmercury goals and associated biota-water relationships may also be used as the bases for any future waste load allocations for point sources and future implementation guidance.

5.2 Mercury Mines in the Cache Creek Watershed

The TMDL reports identified fourteen inactive mines in the Cache Creek watershed. Eleven sites were mined for mercury. Miners extracted gold at four sites and may have used mercury to amalgamate the gold. Table 5.1 identifies the mines discussed in the TMDL reports. The mines are separated by ownership (i.e., properties held by one owner are grouped) and identified as either being publicly or privately held. Any other mercury mines or prospects identified after the Basin Plan Amendment is adopted may be incorporated into the implementation plan during future review periods.

The goal of the implementation plan is to eliminate inputs from the mine sites that are related to anthropogenic activities and restore the streams as closely as possible to background conditions. Implementation of the plan will reduce the loads of mercury discharged to the tributaries of Cache Creek and eventually the Delta. Reduction of mercury discharged from mines will result in decreased sediment concentrations and subsequent methylmercury production. The TMDL report quantifies the mercury load from the mine sites based on existing information; as additional data are collected the loading patterns could be revised. Mercury discharged from the mines is primarily due to erosion of mine waste piles, tailings, and overburden (Churchill and Clinkenbeard, 2004; Tetra Tech, 2004).

To control mercury discharges from the mine sites, Regional Board staff is proposing that the Regional Board adopt cleanup orders (e.g., Cleanup and Abatement Orders) for each of the mine sites that have been assigned a load allocation that requires a reduction of mercury discharged. The cleanup orders would contain provisions for remediation of the mine site, compliance time schedules, and a monitoring program to demonstrate compliance. Typically, the orders would require the mine owners to develop and implement plans to characterize the wastes and load discharges from the sites. As necessary, the mine owner, with Regional Board oversight, would determine baseline loading patterns and background or pre-anthropogenic mercury concentrations and loads. Mine owners would be required to meet the load allocations determined by the Regional Board. A time schedule for orders to be adopted by the Regional Board and implemented is given in the proposed Basin Plan Amendment language (Section 2).

Table 5.1 Inactive Mercury Mines in the Cache Creek Watershed

Mercury Source	Watershed	Ownership Status	Estimated Average Annual Total Mercury Load (kg/yr)	Remediation Goal (% reduction of total mercury discharged)
Abbott and Turkey Run mines (a)	Harley Gulch	Private	1-10	95%
Rathburn-Petray mine (a, b)	Bear Creek	USBLM	0.7-20	95%
Petray North and South mines (a)	Bear Creek	Private	0.5-4.6	95%
Rathburn Mine (b)	Bear Creek	USBLM	Not available	95%
Central, Cherry Hill, Empire, Manzanita, and West End mines (a, d)	Sulphur Creek	Private	0.3-8.7	95%
Clyde Mine (c)	Sulphur Creek	USBLM	0.4	95%
Elgin Mine (e)	Sulphur Creek	Private	2.7-9.3	95%
Wide-Awake Mine (f)	Sulphur Creek	Private	0.02-0.8	95%

a. Long-term average annual load estimates from Churchill and Clinkenbeard (2004), based on likely erosion of mine site features.
b. Drainages from the Rathburn and Rathburn-Petray sites enter ravines several miles from Bear Creek. The amount of material reaching and travel time to Bear Creek are uncertain.
c. Average annual load estimates from by Regional Board staff (Appendix B, Sulphur Creek TMDL Report), based on total mercury loads measured within Sulphur Creek and its tributaries and proportional sub-watershed surface areas.
d. The load estimate for the lower Sulphur Creek mines does not include erosion from bank sediments between Cherry Hill and Manzanita mines, which could add several kg/year in storm events (Churchill and Clinkenbeard, 2004). Based on data collected in six storms, the average load from the lower Sulphur Creek mine area, including banks but excluding Jones Fountain of Life, was 7 kg/yr.
e. Lower estimate by Regional Board staff from the Sulphur Creek TMDL. Upper estimate, by Churchill and Clinkenbeard, is uncertain because of uncertainty in rates of erosion from the site.
f. Lower estimate by Churchill and Clinkenbeard (2004). Upper estimate by Regional Board staff in the Sulphur Creek TMDL.

The mine owners are the entities with the primary responsibility for reducing mercury discharges. Regional Board staff will work within the regulatory framework to name the existing owners and use reasonable efforts to determine other responsible persons or corporations that may have owned and/or operated the mines. Regional Board staff will continue to work with downstream NPDES dischargers that are developing mercury-offset programs to investigate the possibility that the mine sites in the Cache Creek watershed are potential candidates for mercury offset projects.

The TMDLs specified that the inactive mines be assigned a 95% load reduction of the mercury discharged into Harley Gulch, Sulphur Creek, or Bear Creek. To meet the water quality objectives, essentially the discharge associated with mining operations should be eliminated. Stated differently, the only permissible discharge from mine property is that naturally generated by erosion of undisturbed soil with background concentrations of mercury. Continued discharge of mercury in a natural spring on the mine site is allowable. Mercury loads above the spring's baseline discharge caused by interaction of spring water with mine wastes, however, should be eliminated (See Section 5.6).

A 95% load reduction in mass loading from a mine is achievable if mine wastes are protected from environmental exposure. The remaining 5% of the allocation is for variability in the background concentrations and infeasibility in achieving a "zero" mercury discharge from anthropogenic activities. Many of the sites are in highly mineralized zones where naturally elevated concentrations of mercury are not subject to control actions. Staff recognizes that retaining all wastes on site may be difficult, given

winter storm that are unpredictable and major storm events are infrequent. Because much of the mercury is mobilized during major erosional events, remediation actions should be designed to function in these situations. A feasibility study of the mines listed above suggests that a goal of 95% reduction for mine discharges is technically attainable (Tetra Tech, 2004). For comparison, the total metal loading from many remediated copper and zinc mines in the Central Valley has been reduced by 90-100% (Personal communication from Regional Water Board Redding staff).

The load reductions for the mine sites may be accomplished through a variety of engineering actions including, but not limited to, surface water diversion (run-on and run-off control), erosion control, landslide stabilization, regrading, waste pile containment, capping, relocation or removal, and revegetation. Tetra Tech (2004) has prepared an engineering feasibility report that discusses remediation options, effectiveness, and estimated costs for sites listed in Table 5.1. Table 5.6 summarizes this information. As part of the feasibility studies, some mine sites contain buildings, equipment, or other features that should be evaluated for historical significance and options for preservation.

Streambeds and stream banks adjacent to and down gradient of the mercury mines have elevated concentrations of mercury in sediment. (See Section 5.3 for more information on mercury in streambeds). After the mine sites are remediated to reduce total mercury discharges to the creeks, it will be necessary reduce sediment mercury concentrations within the creek bed and floodplain to achieve the proposed goals and objectives. Mine owners are initially responsible for soils with mercury adjacent to and immediately down gradient of the mine site; sediments with elevated concentrations of mercury further from the mine sites may have to be remediated in a collaborative effort between mine owners, landowners and land management agencies, and other entities participating in a mercury offset program. Regional Board staff is in the process of defining the extent of sediments containing mercury in the Cache Creek canyon (See initial data in Appendix D). It may be possible that localized areas containing high concentrations of mercury could be removed or stabilized to prevent from being eroded back into the creeks[10]. The Regional Board will determine funding opportunities to further define loading patterns and stream reaches prone to erosion and to evaluate options to remediate creek sediment.

Sulphur Creek Sediment Implementation Goals

The mines in the Sulphur Creek watershed discharge into a creek that has naturally occurring geothermal springs containing elevated levels of metals and inorganic constituents. Due to the absence of fish, a water quality objective is not proposed for Sulphur Creek. However, staff is proposing implementation goals for sediment that are based on background or pre-anthropogenic mercury concentrations in soils (Pearcy and Petersen, 1990). These concentrations are 0.2 mg/kg, dry weight in non-mineralized areas (Churchill and Clinkenbeard, 2004) and 3 mg/kg in mineralized zones (Pearcy and Petersen, 1990), applied to the average of mercury concentrations in samples fine-grained soil entering Sulphur Creek. Concentrations at undisturbed areas at various mine sites range from 1-390 mg/kg (Churchill and Clinkenbeard, 2004). The goal for mineralized zones is intended as a guide for cleanup efforts and may be adjusted as more information is gathered during feasibility studies at individual mine sites. Due to limited data, it will be the responsibility of the mine owners to develop remediation plans and propose mine clean-up levels necessary to meet the background targets. Regional Board staff will provide oversight of cleanup level determinations.

[10] Cleanup actions in the Cache Creek canyon may change if the State or US Congress designates the area as wilderness.

5.3 Erosion of Mercury in Enriched Soils

The Cache Creek watershed and, to a significantly greater extent, the Harley Gulch and Sulphur Creek watersheds are naturally enriched in mercury. The lowest concentration of mercury in soil in the watershed, as observed in areas distant from mines or springs, is in the range of 0.1-0.2 mg/kg, dry weight (Churchill and Clinkenbeard, 2004; Regional Board data in Appendix D). Regional Board staff considers 0.2 mg/kg to be the regional background mercury concentration. In ore deposits, zones elevated in mercury extend outward from the most concentrated deposit. Mercury in undisturbed, mineralized soil of the Sulphur Creek Mining District, which includes the Harley Gulch mines, ranges 1-390 mg/kg (Churchill and Clinkenbeard, 2004). In addition to the mined areas, there are portions of the Cache Creek watershed that are moderately enriched in mercury, but concentrations were too low to warrant extraction. Fine-grained sediment in some tributaries of the Cache Creek canyon, including Harley Gulch, Judge Davis Creek, Crack Canyon, and Davis Creek, is more than double the regional background (Appendix D; TMDL Report Table 3.12).

The Cache Creek TMDL report identifies erosion of non-mine site soils as a significant source of mercury in the Cache Creek watershed. Mercury in non-mined soils accounts for 20% or more of the mercury load in Cache Creek and its tributaries. The Regional Water Board recognizes that naturally occurring mercury sources may not be entirely controllable.

Anthropogenic activities, including grazing, road construction, and firewood collection activities typically increase erosion rates. To reduce new mercury inputs to the watershed, the proposed Basin Plan amendment contains a prohibition of erosion from new and future anthropogenic activities that results in increases of methylmercury or mercury loads from mercury-enriched areas (defined as average concentration in silt/clay fraction of 0.4 mg/kg or greater). In the enriched areas, loads of mercury rising from erosion due to anthropogenic activities must decrease.

To control erosion of soils containing elevated levels of mercury, these areas must first be identified for their mercury content and erosion potential. Regional Board staff will conduct additional studies to identify subwatersheds with elevated mercury concentrations in soil and stream sediment. The land management agencies (US Bureau of Land Management, State Lands Commission, California Department Fish and Game, and the Counties of Lake, Colusa, and Yolo) will be required to evaluate existing data and coordinate with the Regional Board to assess their watersheds for mercury-enriched zones. Regional Board staff will be responsible for identifying mercury-enriched areas of concern on private property.

Once areas of elevated mercury have been identified, erosive areas containing mercury need to be protected, stabilized, or removed to prevent continued erosion. The focus of the implementation plan will be on anthropogenic activities that result in increased erosion. Projects or land uses that contribute either directly or indirectly to increased erosion need to managed to minimize impacts. The planning and implementation of management practices to control erosion need to be monitored and enforced. Landowners (public and private) will be required to submit erosion and mercury control plans to the Regional Water Board. The land management agencies listed above should evaluate land management projects and practices with respect to erosion control efficacy. It is recommended that the public land management agencies include erosion reduction goals in land management plans. Stringent erosion

control programs must be instituted for any change in land use, development, restoration, or other projects. All agencies issuing land use or construction permits will be responsible for reviewing plans and complying with the Basin Plan. Public and private landowners may coordinate watershed erosion control projects and are encouraged to develop a watershed approach to controlling erosion. Alternatives for implementation of erosion control are discussed in Section 5.9.

The Regional Board will coordinate with the agencies named above and landowners to implement erosion control practices and will assist to the extent possible with funding and grant opportunities. Staff will also review land management plans (including grazing, timber harvest, firewood collection, off-road vehicle use, and agriculture) with emphasis on erosional areas with elevated mercury in soils. To ensure compliance with the requirement for decreased mercury loads in mineralized zones, the Regional Water Board will consider adoption of conditional waivers or waste discharge requirements if erosion-control plans are not submitted and implemented.

Grazing in the Cache Creek watershed occurs on public and private lands. The US Bureau of Land Management (USBLM) currently leases land for grazing in parts of the Cache Creek watershed, but not the Sulphur and Bear Creek watersheds. The USBLM has issued grazing moratoriums on portions of the Cache Creek watershed to protect areas that were overgrazed. Regional Board staff recommends that grazing moratoriums be reviewed for their effectiveness against erosion. The moratoriums should be either renewed or amended to further reduce erosion in mercury-enriched areas. There may be some areas of public land where new grazing plans are necessary. In some cases it may be necessary to fence portions within the mining districts where background soils are greater than 0.4 mg/kg mercury. Mine owners may also need to protect their mine remediation projects from erosion due to grazing.

The Regional Board has staff that reviews California Department of Transportation (Caltrans) projects for road construction and maintenance. Caltrans projects adjacent to waters on the federal 303d list warrant additional management practices to prevent non-point source pollution. Caltrans projects in the Cache Creek watershed may involve disturbance soils that contain mercury. As projects are brought to the Board for review or approval or permits, Regional Board staff will review the proposed projects to ensure that they institute the highest level of management practices for erosion control. Staff may require pre- and post-project water and sediment quality monitoring to demonstrate management practices effectiveness. Staff also recommends that local road maintenance and improvement projects (local counties and USBLM) implement Caltrans' or equivalent management practices to minimize erosion from mercury-enriched soils. Off-road vehicle roads and trails should be maintained to limit erosion and access restricted in mercury-enriched areas.

The proposed Basin Plan amendment requires all projects that create a disturbance within the 10-year flood plain below mined areas[11] to submit erosion studies and mercury and methylmercury remediation plans. Through the 401 Certification process, the Regional Board will require project proponents to evaluate mercury and methylmercury production and transport through and within the project area prior to any construction. The Regional Board will require remediation if projects increase mercury erosion or methylmercury production. Project proponents will be responsible for pre and post-project monitoring and determining compliance with mercury reduction efforts. The US Army Corps of Engineers or local

[11] Cache Creek from Harley Gulch to outflow of the Settling Basin, Bear Creek below tributaries draining the Rathburn and Petray Mine sites, Sulphur Creek, and Harley Gulch.

agencies may conduct flood control projects, including possible projects for flood protection for the City of Woodland and other portions of Yolo County. Any disturbance of the lower Cache Creek levee system may effect erosion of sediments containing mercury. Yolo County conducts multiple projects, such as bridge repair, bank stabilization, and campground maintenance that may be affected by these proposals.

The proposed Basin Plan Amendment requires native riparian plant restoration or invasive species plant removal projects to use best management practices to control erosion. Projects conducted on stream banks must replant with native vegetation or incorporate other bioengineering or biotechnical stabilization solutions into the project. If net erosion occurs after the project or the management practice requirements are not met, further monitoring and mediation will be required. The purpose of these requirements is to ensure that projects within the creek channel are managed to minimize additional erosion of sediments that contain sediment. Project proponents may demonstrate that specific projects may be exempt from the requirements if the proponents provide information that the project does not involve disturbance of soils containing greater than 0.4 mg/kg. The demonstration should include monitoring total mercury in the fine (<60 microns) fraction of the sediments and include five samples per acre of disturbance. All existing erosion control and turbidity objectives contained in the Basin Plan or streambed alteration permits still apply to these projects.

5.4 In-stream Sources of Methylmercury and Mercury

The TMDL report also identifies sediments in creek beds and creek banks that contain elevated levels of mercury as sources of total mercury and methylmercury to Cache Creek, the Cache Creek Settling Basin, and the downstream Yolo Bypass. In-channel erosion of previously deposited mercury in sediments may account for up to 85% of the total mercury load in Cache Creek. As noted earlier, the goal of this implementation plan is to reduce mercury concentrations in sediment and to reduce methylmercury production from the sediment. Staff are proposing that agencies (the USBLM; CDFG; Yolo, Lake, and Colusa Counties; US Army Corps of Engineers; and City of Woodland) be responsible for implementing best management practices and developing and implementing control plans for erosion control, re-vegetation, bank stabilization, and identification and removal of sediments containing mercury. Projects within or adjacent to the 10-year flood zone should be evaluated for their potential effects on mercury and methylmercury production and discharge into Cache Creek.

In Cache Creek at Capay, the Yolo County Flood Control and Water Conservation District operates an inflatable dam that is used during the summer months to divert creek water to irrigation canals. The diversion dam is deflated in the fall and Cache Creek then flows into the main channel. Some sediment that accumulates behind the dam each summer flushes downstream during winter storm flows. Concentrations of mercury in the trapped sediment are likely in the range of 0.5-1 mg/kg (concentrations measured at Yolo and Rumsey, respectively). YCFCWCD provided a report in March 2005 that estimates less than 2 kg of mercury are stored in sediment upstream of the dam (YCFCWCD, 2005). Based on the report, at this time staff is not recommending actions with respect to sediment removal or dam operations. The TMDL report (Appendix A, Section 4.1.4) also describes studies that suggest the impoundment behind the Capay dam seasonally had high levels of methylmercury. Future regulatory activities or projects to modify dam characteristic or operations may require YCFCWCD to evaluate the operations of the Capay diversion dam and propose plans to minimize methylmercury production.

5.5 Mercury in Geothermal Waters

Multiple geothermal springs flow into Sulphur Creek, providing an estimated 12% of the total mercury load to that creek. There is also a spring on the Turkey Run property that discharges to Harley Gulch. Geothermal waters not associated with mine wastes are considered to be part of the natural background conditions. The TMDL does not require that discharges from these springs be reduced. In some cases, such as springs that surface within the streambed, treatment may be technically infeasible. For some springs, however, treatment may be an effective way to decrease mercury loads. These geothermal discharges to Sulphur Creek are potential candidates for remediation or mercury offset projects. The scope of the remediation strategy should be made by the property owner in conjunction with parties interested in the offset.

Geothermal springs at Turkey Run, Elgin, and possibly other mine sites, interact with mine wastes, thereby facilitating transport of mercury from these sites. Water flowing through adits, waste rock and tailings piles can solubilize and increase the transport of mercury, beyond the inputs from erosion of mercury-containing soil and rock particles (Rytuba, 2000). Water flowing through the mine workings and rock piles, termed mine drainage, can be geothermal in origin or a combination of geothermal, freshwater spring, and infiltrated rainfall. The increase in loads due to water/rock interactions in excess of the natural geothermal inputs shall be eliminated as part of the mine site cleanups. The impacts of the geothermal springs on mercury loading may be reduced by routing the spring flows around mine wastes or constructing treatment systems to remove mercury and sulfate.

5.6 Methylmercury in Wetlands and Reservoirs

Water impoundments and wetlands are significant sources of methylmercury production. Methylmercury production is enhanced when wetlands and reservoirs are downstream of mercury mines or in watersheds with elevated sediment mercury concentrations. In Cache Creek, the highest methylmercury concentrations were observed in seasonally flooded impoundments (Capay Dam and Cache Creek Settling Basin; Heim *et al,* 2004). High methylmercury production rates have also been found in the Davis Creek Reservoir (Slotton *et al.*, 2004). Wetlands in the Sacramento-San Joaquin Delta Estuary were found to have the highest methylmercury production rates and concentrations, relative to other areas of the Delta (Heim *et al*., 2004).

It is not known if there are proposals for new reservoirs or impoundments for either flood control or water storage in the Cache Creek watershed. Regional Board staff proposes that any water storage or wetland project be thoroughly reviewed for its potential to create an environment favorable for methylmercury production. If the project has the potential to generate methylmercury, the project must be redesigned to eliminate additional methylmercury loading to Cache Creek or tributary or provide an acceptable remediation plan to minimize the effects of the methylmercury production.

The TMDL discusses a wetland area downstream of the Abbott and Turkey Run mines that is a source of methylmercury to Harley Gulch. Inorganic mercury from the mines flows into and across the wetlands. The wetlands likely contain elevated levels of mercury in sediment that contribute to methylmercury production. After the mines are remediated to eliminate mercury discharges to the wetland, the wetlands should be remediated to reduce methylmercury production.

Historically, the lower reaches of Cache Creek have been mined for aggregate. Today, aggregate mining is conducted off the main channel. The Cache Creek Resources Management Plan describes intentions to restore the areas mined for gravel to a combination of agriculture and open water, wetlands, and woodland habitats (Yolo County, 2002). Regional Board staff encourages Yolo County and others involved to proceed with the restoration plans while considering the proposed requirements to limit increased methylmercury production. Mercury present in the sediment is likely to be methylated and made available to wildlife feeding in both the creek and restored wetlands or ponds. Any surface water discharge from restored wetlands or ponds is prohibited from causing a net increase in methylmercury concentration in Cache Creek. This requirement applies individually to any future gravel mine pit or restoration project. Yolo County and with the gravel mining industry should consult with Regional Board staff to determine how established gravel pits could be maintained and how new excavations could be constructed and operated to ensure no net increase in methylmercury discharge to Cache Creek.

The Cache Creek Nature Preserve (CCNP) incorporates a wetland restored from an area of gravel mining. Following observations of elevated methylmercury levels in water and biota in the wetlands, relative to source water (Slotton and Ayers, 2004), the CCNP moved quickly to halt continuous flow of irrigation return water through the wetlands to Cache Creek. Under the proposed Basin Plan Amendment, the CCNP wetlands may continue current operations.

Because methylmercury in off-channel pits and wetland areas is available to biota, the proposed amendment requires that these areas be designed and operated to minimize methylmercury production or discharge. Regional Board staff will review proposals for new impoundments for their potential of methylmercury production and impact on biota.

5.7 The Cache Creek Settling Basin

Water and sediments that contain mercury flow from the mines and creek beds through the downstream Cache Creek Settling Basin before entering the Yolo Bypass and the Sacramento-San Joaquin Delta. The settling basin was designed to contain erosional material to reduce sedimentation of the Yolo Bypass and to reduce downstream flooding. The settling basin traps about 50% of the sediment and total mercury during high flows (Foe and Croyle, 1998; Cache Creek TMDL report). Staff proposed that if the basin were redesigned to trap more sediment, then the settling basin would retain additional mercury. An independent project by other agencies (City of Woodland, Department of Water Resources, and US Army Corps of Engineers) involves evaluating additional flood control protection for the City of Woodland. Flood control options may involve modifying the levees and the weir height of the Cache Creek settling basin for increased flood protection. Some flood control projects may affect the ability of the settling basin to retain sediments that contain mercury. As part of implementation planning, Regional Water Board staff coordinated a joint study of improvements to the settling basin for increased mercury and sediment retention. The Army Corps of Engineers, Calfed, and the Regional Water Board funded the study. To date, the consultant has performed computer modeling of baseline conditions and various modification possibilities to increase mercury retention. The initial results indicate that the basin operation and design could be modified to remove up to an additional 43 kg/yr (CDM, 2004). Options include raising the outlet weir height earlier than originally planned (2009 versus 2018), enlarging the basin, and excavating sediment on a periodic basis.

Requirements for the Cache Creek Settling Basin will be included in the Basin Plan Amendment for mercury in the Sacramento-San Joaquin River Delta. Prior to completion of the Delta report, Regional Water Board staff proposes to use this preliminary information to coordinate with DWR and the USACE to evaluate planning and implementation of improvements (operational and modifications) to the settling basin. It may be possible that settling basin improvement projects could be part of a mercury-offset program developed by NPDES dischargers.

5.8 Public Outreach and Education

A necessary component of all mercury strategies is public education. Public outreach would accompany any of the implementation alternatives discussed below. Until the water quality objectives are attained, the public should continually be informed about safe fish consumption levels. In May 2004, OEHHA circulated a draft consumption advisory for Cache Creek. While a fish advisory will be read by some, it may not reach parts of the population that are at risk of consuming locally-caught fish. Sensitive groups of consumers, such as pregnant women and children, may not catch fish themselves and are less likely to receive the advisory information.

To augment existing efforts to publicize the draft fish consumption advisory, the proposed Basin Plan amendment requires additional outreach and education in the Cache Creek area. Education should be directed toward portions of the population that may be particularly at risk, such as pregnant women and children and those with high consumption rates. The proposed Basin Plan amendments name the public health departments of Colusa, Lake, and Yolo Counties as the lead agencies for education and outreach. The USBLM will also be requested to post signs at their points of access to Cache and Bear Creeks. The Regional Water Board and the California Department of Health Services will coordinate with the counties and USBLM to provide these services. Education efforts may include recommendations to eat smaller fish and species having lower mercury concentrations.

5.9 Atmospheric Deposition

Atmospheric loads of mercury are minimal when compared to the mine sources and background soils. Atmospheric loads will not significantly decrease with this control program and are expected to remain at the current loading estimate of 0.02 kg/year for the entire Cache Creek watershed.

5.10 Implementation Alternatives Considered

Three alternatives were considered for Regional Water Board's implementation plan for achieving the fish tissue water quality objectives and water and sediment goals. The first is the "No Action" alternative, under which no active remediation would be required. The other two alternatives require some level of active remediation. The TMDL specifies the degree to which the mercury sources must be reduced to achieve the objectives. The following alternatives propose different approaches to achieve the objectives through various remediation options to reduce mercury loads from selective sources. Alternatives with more aggressive cleanup strategies are expected to achieve the objectives sooner, but at a more substantial cost. Alternative 2 is considered to be a baseline cleanup effort while Alternative 3 includes the elements of Alternative 2 with additional proposed remedial actions. In all alternatives, the contribution from the atmospheric mercury pool is assumed to be constant and not assigned a load reduction.

All of the implementation alternatives, including the No Action alternative, will require outreach to educate the public regarding the levels of fish consumption that may cause adverse health effects. Regular reporting to the Regional Water Board regarding progress toward meeting objectives is proposed for all alternatives.

As discussed in the TMDL linkage analysis, methylmercury concentrations in fish tissue are correlated to median methylmercury concentrations in the water column. The alternatives are designed to reduce mercury sediment concentrations that in turn are expected to result in decreases of methylmercury fluxing into the water column. The time to reach the aqueous methylmercury implementation goals is dependent of the efforts to reduce sediment concentrations and address other factors influencing methylmercury production. Significantly lowering the sediment mercury concentrations may require decades, because mercury from mineralized zones and mines has contaminated the stream bed and banks for long distances downstream. When methylmercury concentration have stabilized at the safe levels, and allowing for turnover in the fish population, staff estimates that fish tissue objectives would be achieved within ten years.

Under each implementation alternative, the Regional Water Board will review progress toward meeting the water quality objectives and load allocations every five years. The alternatives involving deliberate control actions also incorporate an adaptive management approach. For each 5-year review, staff will evaluate recent scientific information regarding methylmercury and mercury reductions to determine the most effective implementation program.

Regional Board staff proposes to assist with monitoring and identifying mercury sources. Staff will be available to assist agencies and landowners in securing funding for control projects. Some projects may be eligible for funding under future mercury offset programs.

In general, the implementation of the load reductions will be accomplished in a phased approach. The first phase consists of the Regional Board working in conjunction with the landowners to identify areas of elevated mercury and methylmercury in sediment and water. The first phase would also require that landowners, to evaluate the feasibility of projects to reduce mercury and methylmercury loading from areas with elevated mercury concentrations or methylmercury production. As projects are identified, the Regional Water Board would then consider whether to require the landowners to implement the project for the second phase.

Implementation Alternative 1 No Action (400+ years for passive cleanup)

The No Action alternative relies completely on continued natural erosion and transport of sediments containing mercury out of the system and passive dilution of streambed sediments by cleaner, incoming sediment to decrease concentrations of mercury in surficial sediment thereby decreasing methylmercury production. The No Action alternative consists of status quo of the mercury mines in the Sulphur Creek mining district and streambed sediments with mercury in the Cache Creek watershed. Mercury in soils would continue to be eroded from the mines directly into Harley Gulch, Bear Creek, and Sulphur Creek. Sediments containing mercury would continue to be washed down the tributaries into the mainstem of Cache Creek, where they would be transported to the Cache Creek Settling Basin (where a portion of the sediments would be retained prior to the settling basin filling with sediments and spilling into the Yolo

Bypass) and eventually the Delta. Alternative 1 would include public outreach and education regarding consumption of contaminated fish.

Appendix D contains the results of a sediment survey conducted by Regional Water Board staff in late 2003. Staff surveyed Cache Creek between the North/South fork Cache Creek confluence and Bear Creek. Sediment mercury concentrations were measured and sediment volumes were estimated. The calculated total mercury mass was between 9,000 and 500,000 kg. Given that the Cache Creek settling basin imports an average of 370 kg/yr (range 40-1020 kg/yr) and assuming the higher estimate of mercury present, the time for sediment within the Cache Creek canyon to be mobilized by large storm events to the settling basin could be 400-500 years.

The above time estimate assumes that current discharges from the mines remain constant. The total, average annual load from the mines in Sulphur and Bear Creeks and Harley Gulch is estimated around 20 kg/year[12]. Major erosion events would increase loads beyond these estimates. The total estimate of mercury remaining in waste rock, ore and tailings piles on the mine sites is 34,000-52,000 kg[13].

In addition to relying on centuries of major storm events to mobilize the sediments downstream, the north fork Cache Creek will continue to eroded and deposit cleaner sediment (<0.2 mg/kg) in the Cache Creek canyon, thus diluting the sediment containing mine-wastes. This cleaner sediment dilution and burial of the sediment with higher concentrations of mercury could reduce the time for achieving objectives to an estimated 300-400 years.

It is highly unlikely that the sediment goals and fish tissue objectives would be reached through passive sedimentation alone in a reasonable time.

Implementation Alternative 2

The mercury controls proposed for Alternative 2 are a combination of several projects in the Cache Creek watershed to reduce the erosion and transport of mercury and generation of methylmercury. Alternative 2 is labeled a 'baseline' alternative and Alternative 3, described below, incorporates the elements of Alternative 2 and includes additional control options. Table 5.2 summarizes the projects or activities proposed for Alternative 2.

The first component of Alternative 2 is for the Regional Board to issue cleanup orders to the owners of the mercury mines listed in Table 5.1. Section 5.1 describes the proposed approaches and rational for the mine cleanup. As part of implementation planning, Regional Board staff has initiated the process of researching mine ownership and drafting enforcement orders. Staff expects to issue orders to each of the mines assigned a load reduction. Plans and time schedules for remediation will be included in the orders for each mine site. Mine owners are expected to determine cleanup levels that are consistent with the TMDL targets and load allocations described in Table 5.1and Appendices A and B (TMDL reports). Staff proposes that the permitting process be completed by June 2006.

[12] See TMDL reports. Estimated loads are: Harley Gulch, 7 kg/yr; Sulphur Creek total load minus thermal springs, 10.5 kg/yr, and Bear Creek total loads minus inputs from Sulphur Creek and upstream of mine-related tributaries, 3 kg/yr.

[13] Churchill and Clinkenbeard, 2004. Estimated as volume of pile times measured mercury concentration for piles that potentially could erode to water bodies of concern. Does not include loads that would erode inward to pits. Estimates by watershed are: Sulphur Creek, 3400-4400 kg; Harley Gulch, 18,400; and Bear Creek, 11,800-29,300 kg.

A wetland area that needs to be addressed is south of Highway 20, downstream of the Abbott and Turkey Run mines. First, the upstream mines must be remediated to minimize the discharge of total mercury into the wetlands. After the mines are restored, methylmercury generated by the wetlands and entering Harley Gulch should be controlled. Remediation of the wetland could include removing sediments containing mercury, rerouting water flow, reducing residence time of the water, and other options. The Abbott and Turkey Run mine owners are responsible for remediation of the wetlands.

Under Alternative 2, mercury in creek banks and floodplains will be addressed by requiring that land managers and owners (USBLM; State Lands Commission (SLC), California Department of Fish and Game (CDFG); Yolo, Lake, and Colusa Counties and private landowners) develop and implement management practices to reduce the release of sediments containing mercury. The Regional Board will take the lead to conduct studies to further refine total mercury sources. As sources are identified, the Regional Board would require landowners to submit a report that evaluates engineering options or management practices to reduce methylmercury concentrations and total mercury sediment concentrations. At completion of the studies and feasibility reports, the Regional Board would consider whether to require the landowners to implement a project. Control plans should evaluate re-vegetation, bank stabilization, other methods of erosion control, and the feasibility of removal of sediments containing mercury. Environmental reviews for projects or activities undertaken within the floodplain must evaluate the potential effect on erosion and mercury transport.

Initial staff surveys indicate that mine related wastes are present in the canyon downstream of Harley Gulch to the confluence of Cache and Bear creeks. Staff estimates 5.6×10^6 cubic yards and between 9,000 and 500,000 kg of mercury are contained within the banks of Cache Creek. Of this amount, about 1.8×10^6 cubic yards is present in the three miles downstream of Davis Creek, at a concentration of 2 mg/kg, dry weight (See maps in Appendix D). Removal of some of this material may be the most cost efficient versus other stream reaches. Also, as much of the Cache Creek canyon is inaccessible, this area may be approached by existing roads or trails that lead to Buck Island or are on private property. Designation of the Cache Creek canyon as a Wilderness study area, and/or proximity of candidate locations to traditional cultural sites could affect the feasibility of remediating some sites.

In particular, the USBLM would be requested to coordinate with Regional Board staff to further evaluate the sediments containing mercury at the mouth of Harley Gulch. USBLM would be required submit a report on potential options to reduce mercury releases from the delta. The Harley Gulch delta contains an estimated 16,000 cubic yards of sediment and 15-20 kg of mercury[14]. Stabilization or removal of the mine wastes in the delta, or rerouting the creek around the delta would prevent further transport into Cache Creek during high flows. There may be some additional erosion control and bank stabilization measures to reduce mercury inputs. Accessibility to the delta is limited as no roads or significant trails exist. Potentially, small earth moving equipment could be lifted by air into the delta area so that trail construction would not be necessary. Feasibility would depend, in part, on whether remediation could be designed to avoid disturbance to archaeological and traditional cultural sites in the watershed. After the USBLEM submits an evaluation report, the Regional Water Board would then consider whether to require USBLM to implement the project.

[14] Average sediment mercury concentration is 3.2 mg/kg, dry wt, as measured in fine/medium grains > 1mm (CDFG, 2004a). Assumes mercury-containing sediment is 30% of total sediment volume in Delta (1.5 acres X 2 meters deep).

Table 5.2 Implementation Alternative 2 Projects

Project or Activity	Project Responsibility
Mercury mine remediation (includes adjacent stream bed and bank cleanup, wetlands downstream of Turkey Run mine, and geothermal springs flowing into mine wastes).	Mine owners
Additional studies for mercury sources, evaluate projects for erosion prevention or sediment removal in creek banks and floodplains, implement feasible projects.	Regional Water Board to coordinate additional studies; USBLM, SLC, CDFG, Yolo, Lake and Colusa Counties, private landowners. Some control actions may be possible offset projects.
Additional studies for Harley Gulch sediment delta, evaluate projects for erosion prevention or sediment removal, implement feasible projects.	Regional Water Board to coordinate additional studies, USBLM.
Continued and improved erosion projects (grazing moratoriums, management practices to control erosion, road construction and maintenance) on enriched soils in the watershed (0.4 mg/kg, or 2X the local background concentration).	Land owners, Caltrans, local road departments
No new sources or net increases of mercury or methylmercury (land use, impoundments, wetlands, restoration projects).	Land managers
Evaluate and minimize methylmercury from wetlands in former gravel excavations.	Yolo County, Cache Creek Conservancy
Additional studies for methylmercury sources in Anderson Marsh, evaluate management options, implement feasible projects.	Regional Water Board to coordinate additional studies, CA State Parks, other responsible parties
Additional studies for methylmercury and mercury sources in Cache Creek and Bear Creek, evaluate activities than increase erosion, develop and implement erosion control plans.	Regional Water Board to coordinate additional studies, land owners
No additional mercury or methylmercury discharges from the Wilbur Springs Resort	Wilbur Springs Resort owners
Prohibition on anthropogenic activities that result in increases of methylmercury or mercury loads.	Regional Water Board, landowners
Evaluate control of geothermal discharges in Sulphur Creek	Potential mercury offset project
Outreach and education regarding fish consumption	Lake, Colusa, and Yolo Counties, and CDHS

A component of Alternative 2 includes the continuation, improvement, and development of new erosion control projects within the Cache Creek watershed. Section 5.2 identifies various elements for erosion control and potential responsibility. Land uses potentially effecting mercury erosion and methylmercury production include grazing, firewood collection, timber harvest, road maintenance and construction, land development, and stream restoration projects. Alternative 2 proposes erosion control in with two components:

1) Erosion from human activities on soils enriched in mercury must be reduced, through submission of erosion control plans and implementation of best management practices. Regional Board will continue monitoring in sub-watersheds and take the lead on identifying areas enriched in mercury (defined as soil/sediment concentration >0.4 mg/kg mercury). Increased erosion from land use changes or future activities is prohibited.
2) The 10-year floodplains downstream of mining areas are considered enriched in mercury. This includes Cache Creek between Harley Gulch and the Settling Basin outflow. Projects in the enriched, 10-year floodplain that may cause erosion are required to monitor and maintain a no net increase in erosion. Mitigation by removal of mercury elsewhere is an option if erosion from the project is unavoidable. Native plant restoration and invasive species plant removal must implement best management practices.

Agencies responsible for controlling erosion include the USBLM; SLC, CDFG; Yolo, Lake, and Colusa Counties and private landowners. The time schedule for compliance with erosion control requirements varies by project type but in general would require planning and implementation of revised plans within five years.

Regional Board staff has preliminary identified a few smaller watersheds that contribute mercury to Cache Creek (Harley Gulch, Judge Davis Creek, Crack Canyon, and Davis Creek). Staff will conduct additional studies, in conjunction with landowners, to identify significant total mercury sources in upper Cache Creek (above Rumsey) and in tributaries to Bear Creek. After the Regional Board has identified sources in the tributaries, the Board will require those landowners to submit reports that identify anthropogenic activities on their lands that result in increase erosion (i.e., grazing, roads, timber harvest, mines). The Board will then require landowners and managers to submit erosion control plans and implement the plans after Executive Officer approval.

Alternative 2 includes a requirement that watershed projects are not undertaken that would add new sources of methylmercury or net increases of methylmercury from sources such as water impoundments and reservoirs, wetlands creation, and streambed restoration projects. Section 5.4 describes projects that may have the potential of increasing methylmercury generation, such as restoration of former gravel mines. Staff will review all projects that have the potential for increasing methylmercury generation and require proponents to modify projects or provide remediation in another part of the watershed. There is no time schedule proposed for this part but staff will review projects as necessary.

The Wilbur Hot Springs resort is a source of total mercury to Sulphur Creek. It is unknown if the resort discharges methylmercury or how mercury discharged affects methylmercury concentrations in Sulphur Creek. Alternative 2 proposes that the resort not increase mercury loads to the watershed above their current discharge levels. If the resort intends to expand their use of thermal waters or the number of hot spring bathhouses which discharge waters containing mercury, then staff propose that the owners remediate the increases or participate in an offset program to offset the increases in mercury loads.

A public outreach and education program is discussed in Section 5.7. Education efforts would inform anglers and their families of the quantities and types of fish that are safe to consume and which species and sizes to avoid.

The final components of Alternative 2 would require the Regional Board to continue assessing methylmercury sources within the watershed and require landowners to evaluate other methylmercury load reduction projects. Regional Board staff is continuing to investigate methylmercury production and fate in Anderson Marsh and Bear Creek. Staff also plans to evaluate mercury loading from mines in the Bear Creek watershed during the wet season in 2004-2005. The Regional Board would continue to coordinate implementation and remediation activities, review proposals for non-point source projects, and would assist to the extent possible with funding and grant opportunities.

Anderson Marsh, located at the outlet of Clear Lake, is a wetland area that appears to produce methylmercury that is then discharged to Cache Creek (See Regional Board data in Appendix C). The first step is to determine the magnitude and source of methylmercury generated within the wetland. Staff proposes to conduct additional studies to refine load estimates and methylmercury sources and to consider potential control activities. If the Regional Board finds that Anderson Marsh is a significant methylmercury source to Cache Creek, the Regional Board will require the California State Parks (CSP) to evaluate potential management practices to reduce methylmercury loads. The Regional Board will then consider whether to require CSP to implement a load reduction project.

Implementation Alternative 3

While the projects discussed for Alternative 2 are expected to achieve the water quality objectives, staff evaluated another alternative that would require a more aggressive active remediation program that would provide a greater mercury reduction than proposed in Alternative 2. Like Alternative 2, Alternative 3 would require active remediation early in the implementation program and then rely on natural erosion process to reduce mercury concentrations. Because of the increased level of active remediation of mercury sources, Alternative 3 is expected to achieve the water quality objectives and CTR criteria more rapidly than Alternative 2.

Land owners and land management agencies would be required to evaluate remediation options and conduct feasibility studies to determine the efficacy of remediating more diffuse sources of mercury or methylmercury. Alternative 3 would require the removal or sequestering of soils with mercury concentrations greater than 0.4 mg/kg.

The mercury control projects proposed for Alternative 3 include all of the projects described for Alternative 2 (Table 5.2) and the additional projects described below for the control of methylmercury production and total mercury transport. Alternative 3 projects are more comprehensive and target remedial actions of other mercury sources in the Cache Creek watershed. Table 5.3 summarizes the options proposed for Alternative 3.

Alternative 3 includes remediation of mine wastes that are downstream of the mine sites (Alternative 2 addresses mine wastes on and immediately adjacent to the mine sites, including stream sediments which

contain mercury). For example, this would include sediments containing mercury from downstream of the Central mine to the confluence of Sulphur and Bear Creeks and soils with elevated concentrations of mercury in the Bear Creek valley and canyon. Under Alternative 3, the number of remediation or sediment removal projects and remediation of methylmercury sources in the Cache Creek canyon would be increased over the efforts conducted under Alternative 2.

In addition to the Cache Creek canyon, Alternative 3 would include select removal of sediments containing mercury in lower Cache Creek. Sediment removal or remediation would include stream beds and banks where mercury sediment concentrations are significantly greater than 0.2 mg/kg, dry weight. To maximize the benefits of remediating downstream sediments, it is necessary to remediate the upper watershed prior to initiating work in the lower Cache Creek.

Table 5.3 Implementation Alternative 3 Projects

Project	**Project Responsibility**
Alternative 2 Projects	As above
Implementation of additional projects identified in Alternative 2 to remove increased amounts of sediment containing mercury and control methylmercury production	Land owners Possible mercury offset project
Remediation of mine wastes downstream of mercury mines (e.g., Sulphur Creek confluence with Bear Creek, mine waste in tributaries to Bear Creek)	Land owners Possible mercury offset project
Additional remediation or removal of sediments containing mercury in Cache Creek canyon and Bear Creek	Land owners Possible mercury offset project
Select remediation or removal of sediments containing mercury in lower Cache Creek	Land owners Possible mercury offset project
Active or passive treatment of geothermal springs	Possible mercury offset project
Installation of small sediment basins downstream of tributaries with mercury mines	Land owners Possible mercury offset project

Alternative 3 would address mercury discharges from geothermal springs. As described in Section 5.4, reductions are not required for mercury in thermal spring fluids not associated with mine wastes. For some springs, however, treatment may be an effective way to decrease overall mercury loads in Sulphur Creek. These geothermal discharges are potential candidates for remediation by the landowner or through mercury offset projects. The impacts of the geothermal springs on mercury loading may be reduced by rerouting the spring flows or constructing treatment systems to remove mercury and sulfate. Tetra Tech (2004) describes passive treatment alternatives and a discussion of their costs and effectiveness. Treatment systems would require periodic maintenance in perpetuity.

Another project for Alternative 3 is to locally retain sediment that has previously discharged from the mine sites and is now in the creeks. It would include design and construction of small sediment basins

downstream of tributaries with mercury mines. This would only be effective at capturing sediment that has left the mine site and cannot be reasonably collected by streambed remediation. The mine(s) should be remediated prior to implementation of this option. Potential candidate sites for this approach would be downstream of the Sulphur Creek mines at the Bear Creek confluence and downstream of the Rathburn/Petray mines on unnamed tributaries to Bear Creek. The sediment basin could be engineered to capture 90-95% of the sediment transported during above average storm flows. Higher flow events would have a less efficient capture rate. Period maintenance would be required to excavate accumulated sediment in preparation for the next storm season. Other sediment basin sites have not been identified, but could include basins in Harley Gulch or at the mouth of Davis Creek. Designation of the Cache Creek canyon as a Wilderness study area, and/or the proximity of candidate locations to traditional cultural sites could alter this option.

Alternative 3 includes more stringent erosion control on public and private lands that are erosive and contain mercury concentrations equal to or above 0.2 mg/kg. The Regional Water Board could adopt waste discharge requirements with provisions and prohibitions to control erosion from activities such as grazing, firewood collection, timber harvesting, agriculture, development, road construction and maintenance, and gravel mining. The Regional Water Board may find that sediment discharges could be reasonably controlled by source control or prevention and restoration. The Regional Water Board could then require that agencies develop and follow site-specific erosion control plans for sediment management. Landowners could be required to survey their properties for erosive areas with mercury concentrations above 0.2 mg/kg. If areas were found that meet this criteria, the landowners would propose prevention or restoration projects, effectiveness and compliance monitoring programs, and time schedules with interim sediment discharge goals.

The projects described in Alternative 3 will likely be very expensive. It is possible that funding for remediation of mine-related wastes that have been transported away from the initial site may be available under a mercury offset program. Future Basin Plan amendments may discuss a framework for an offset program.

Table 5.4. Comparison of Implementation Alternatives- Mercury and Methylmercury Reductions

Project (a)	Implementation Alternatives (b)		
	1	2	3
Mercury mine remediations		20 kg/yr mercury (more in severe runoff events)	(same as Alt 2)
Improved erosion control (grazing, road maintenance, firewood) in areas with soil mercury >0.4 mg/kg (c)		1-20 kg/yr mercury	>20 kg/yr mercury
Select remediation or removal of contaminated sediment in Cache Creek canyon and/or Bear Creek (d)		20-200 kg mercury	Possibly hundreds of kg mercury
Remediation or removal of contaminated sediment at mouth of Harley Gulch (e)		20 kg mercury	(same as Alt 2)
Select stabilization or removal of contaminated sediment in Cache Creek downstream of Rumsey		unknown kg mercury	Greater effort than Alt. 2, unknown kg mercury
Small sediment basins in tributaries with mercury mines			Tens of kg/yr mercury at each

			basin
Geothermal springs active or passive treatment (f)		No net increases	1-5 kg/yr mercury plus decrease in methylmercury due to controlling sulfate
Remediation of wetlands downstream of Abbott and Turkey Run mines		0.8 g/yr methylmercury plus removal of unknown kg mercury stored in wetlands	(same as Alt 2)
Anderson Marsh modifications to reduce methylmercury production (g)			1-10 g/yr methylmercury
Table 5.4, continued.			
No new sources or net increases of methylmercury (impoundments, wetlands, restoration projects.)		No Hg removed – prevents new methylmercury inputs	(same as Alt. 2)
Passive erosion, resuspension, and transport through Cache Creek to Settling Basin (h)	Up to 350 kg/yr mercury	(same as Alt 1)	(same as Alt 1)

a) Many projects focus on reducing mercury entering or within the creeks. Methylmercury loads expected to decrease along with the declines in total mercury concentrations.

b) All alternatives include public outreach and education regarding consumption of contaminated fish. Alternatives 2 and 3 also include additional research in Anderson Marsh, Cache Creek and Bear Creeks.

c) Assumes erosion of non-mined soil contributes 20% of total mercury loads (average 80 kg/yr) and anthropogenic activities affect 10-20% of this load. Alternative 3 requires erosion control in all of Cache Creek watershed, which would increase amount of mercury removed.

d) Assume minimum effort would remove at least 20 kg mercury, equivalent to mass in Harley Gulch delta. Maximum estimated effort could possibly address 1% of Hg in contaminated stream banks (20,000 kg in Cache Creek canyon). Alt. 2 and 3 include mine waste in Bear Creek tributaries.

e) Removal depends upon evaluation of feasibility and impact on traditional cultural features.

f) Increase in mercury loads from interaction of spring water with mine wastes eliminated in mine cleanups

g) Assumes Anderson Marsh contributes up to 25% of South Fork Cache Creek methylmercury load.

h) Assumed to be the average mercury load from unknown sources above Rumsey (349 kg/yr). Annual load actually expected to decline slowly under Alt. 2 and 3 as sources entering the creeks are controlled.

5.11 Evaluation of Implementation Alternatives

5.11.1 Attainment of Water Quality Objectives

It is unlikely that the proposed water quality objectives would be attained under Alternative 1 (No Action). This alternative would allow the mine sites to continue discharge at their current rates and for other methylmercury and mercury sources to continue enter the creeks. As noted earlier, natural erosion and sediment deposition will eventually reduce sediment mercury concentrations, but this could take more than 500 years.

Reducing methylmercury concentrations to 0.14, 0.06, and 0.09 ng/L for Cache Creek, Bear Creek, and Harley Gulch, respectively should result in fish tissue concentrations being reduced to levels protective of

humans and wildlife consuming local fish. Water quality objectives and mine cleanup goals are expected to be achieved under Alternatives 2 and 3. The difference between Alternatives 2 and 3 is the level of effort and expense of the various projects. Alternative 2 is a moderate level of effort to reduce mercury loads and methylmercury concentrations. Alternative 3 requires extensive remediation activities and would hasten the time required to reach the interim goals, but at an increased cost. Since both Alternative 2 and 3 propose to control erosion of mercury sources, the amount of total mercury in the water column would be reduced during storm erosional events and compliance with the CTR is expected.

With Alternatives 2 and 3, the time to attain the fish tissue objectives and aqueous methylmercury implementation goals is difficult to predict. A primary intent of the mercury reduction strategy is to reduce the methylmercury produced in the streambeds, where most of it is produced. To reduce concentrations of methylmercury, concentrations of total mercury in the sediment must be decreased. The regional background concentration of mercury in fine-grained soil is 0.2 mg/kg, but the average concentration in suspended sediment at Rumsey is 1 mg/kg. Reducing inputs of mercury from mines and mercury-enriched zones will cause the concentration of total mercury in surficial sediment in the beds and banks of the creeks to decline. Under Alternative 2, the significant inputs of mercury-enriched sediment will be addressed (mines and erosion from enriched, unmined soil). Alternative 2 also addresses the Harley Gulch wetlands and Anderson Marsh, which are hotspots of methylmercury production other than the streambeds. Alternative 3 increases the amount of mercury removed from stream banks and downstream of mines. All of these actions are expected to reduce methylmercury levels.

The primary difficulty in predicting time to attain the objectives is the size of annual mercury loads entering the upper watershed relative to the large mass of mercury presently in the Cache Creek canyon. Mercury loads at Rumsey currently average 400 kg/year. Alternative 2 control actions in the upper watershed have potential to reduce this load by at least 60 kg/year. Alternative 3 actions would further decrease the mercury load at Rumsey, with the result dependent of the breadth of actions. There are, however, 9,000-500,000 kg of mercury stored in the canyon. Although implementation of this Basin Plan Amendment would create measurable changes in mercury loads, full attainment of the objectives may require several hundred years, as the mercury concentrations in the streambeds gradually decline.

For both Alternatives 2 and 3, the majority of the active remediation will occur within 15-20 years after implementation of the mercury control program. After active remediation of the materials and regions containing the greatest concentrations of mercury within the watershed, the plan relies on natural erosion of background soils and uncontaminated material to reduce mercury sediment concentrations to achieve the final water quality objectives. The plan also relies on continued mercury and methylmercury controls throughout the watershed until objectives are achieved.

Staff estimates that fish tissue objectives will be achieved approximately five-ten years (2-3 fish life cycles) after the aqueous methylmercury goals are met. Staff expects more rapid decreases in fish tissue concentrations should occur soon after the major remediation activities are completed, with more gradual declines in fish tissue concentrations occurring as sediment concentrations continue to decline through natural sedimentation. Although the timelines are uncertain, experiences at sites with mercury elsewhere in this country and others support the conclusion that cleanup actions will result in reduced concentrations in fish. Control actions such as treatment of mercury inputs and excavation of mercury-contaminated floodplains have resulted in a halving of fish concentrations in 10-20 years (Turner and Southworth, 1999; See Summary in Section 4.3, Cache TMDL report).

Under implementation Alternative 2 or 3, mercury objectives are likely to be achieved more rapidly in Harley Gulch than in Cache Creek. These alternatives require that all of the major sources of mercury and methylmercury in Harley Gulch, which are the mines and the downstream wetlands, be actively remediated. Erosion in the East Branch Harley Gulch related to Caltrans operations will also be controlled. Unlike Cache Creek canyon, there is little mine waste material stored in the banks of Harley Gulch. A reduction in fish concentrations is expected relatively rapidly (10-30 years) after the proposed plan is implemented. Under Alternative 2, natural discharges from the Turkey Run thermal spring will continue (increased loads caused by interaction of the spring with mine waste must be controlled). After the mines and wetland are remediated, Regional Board staff will evaluate effects of methylmercury from the spring on fish concentrations in the stream.

Likewise, the ongoing sources of mercury in Sulphur Creek are in close proximity to the creek. Assuming the floodplain below mines in the lower Sulphur Creek watershed is adequately remediated with the mines and grazing-related erosion is controlled, it is expected that the sediment implementation goals for Sulphur Creek could be reaching in 10-20 years after remedial actions.

In addition to reducing methylmercury and total mercury loads to protect the beneficial uses of Cache Creek, there is a need to reduce loads from the Cache Creek watershed to protect the beneficial uses of the Sacramento- San Joaquin Delta Estuary (subject to a separate mercury TMDL anticipated in 2006) and the San Francisco Bay. The mercury TMDL adopted by the San Francisco Bay Regional Water Quality Control Board requires that the Central valley reduce its total mercury load by 25% (approximately 110 kg/year) or achieve a mercury sediment concentration of 0.2 mg/kg (current value is 0.26 mg/kg). The current suspended mercury sediment concentration discharging from the settling basin to the Yolo Bypass is 0.5 mg/kg and the 20-year average discharge is 125 kg/year. The Central Valley Regional Board is unlikely to meet Region 2's load allocation without active mine cleanups and other remediation projects describes in Alternatives 2 and 3.

5.11.2 Cost

Estimated costs for mercury control and other activities that might occur under the proposed implementation plan are shown in Table 5.5. Table 5.6 provides the detailed costs for specific remediation projects. These are rough estimates designed to facilitate comparisons between the implementation alternatives. The cost estimates are based on previous mine cleanup projects involving the Regional Board, estimates from Tetra Tech (2004) and cost factors provided by the USGS in a report to the Regional Board (2003).

No construction or maintenance costs are projected for Alternative 1 (No Action), although implementation of Alternative 1 would still have monitoring and public education and outreach costs associated with it. Monitoring and public education costs are estimated in Table 5.6.

Table 5.6 presents a range of remediation costs for mine remediation, including interim and final control measures. Tetra Tech's cost estimates (2004) range based on the type and degree of cleanup, including:

- surface and institutional controls (surface water diversion and fencing),
- type of solid waste containment (soil covers or fully encapsulated waste management units),

- excavation and waste consolidation (disposal on or off-site),
- remediation of mine structures (solids removal around buildings and either leave historic buildings or demolition),
- stream sediment (excavate and on- or off-site disposal, or revegetation and stream bank stabilization),
- surface and geothermal water treatment (e.g., diversion, chemical precipitation, aeration, in-stream and off-stream reactors).

Table 5.5 Cost Summary for Implementation Alternatives

Implementation Alternative	Estimated Implementation Cost
1	$10,000 - $20,000
2	$10.5 - 17 million
3	$50 - 180 million (or more)

As expected, Alternative 1 has the lowest cost. The costs for the other alternatives escalate as each alternative includes projects from the prior alternatives and additional projects. Alternative 2 includes remediation of the mine sites, erosion control, and additional studies. These projects are the majority of the Alternative 2 costs. Major additional costs associated with Alternative 3 are remediation of stream banks, treatment of geothermal springs, and modification of Anderson Marsh. Alternative 3 is the most comprehensive in terms of mercury removal and is also the most costly.

In reality, the cost estimates for each alternative could range greatly depending on the type and completeness of remediation. The amount of cleanup to background conditions at the mine sites is only a best estimate as mine owners would need to determine site-specific cleanup goals and remediation controls. It may be determined that less focus should be on mines contributing lesser amounts of mercury and more focus on mine wastes that have left the mine and is now in the canyon sediment load.

5.11.3 Feasibility

This section discusses the technical feasibility of the four proposed alternatives. Projects are considered technically feasible if current technology and remediation practices are available for the various projects. In general, with sufficient funds, the proposed projects are feasible however, as noted above, costs increase with increasing remediation efforts. Alternatives 2 and 3 were evaluated based on current technology. Alternative 1 is feasible because no implementation plans or remediation activities are proposed.

The projects listed under Alternative 2 are feasible given that mines have been successfully remediated in other parts of the Central Valley. Metal mines such as Walker Mine, Penn Mine, Iron Mountain mine, and numerous smaller mines in the Lake Shasta watershed have significantly reduced their metal loading into surface waters by greater than 90-95%. Mines in the Sulphur Creek should be able to meet reduce erosion and mercury loading by 90-95%.

The other Alternative 2 projects involve planning and previously applied actions (grazing controls, BMPS for erosion, methylmercury studies) and seem to be reasonable approaches. Remediation of wetlands downstream of Abbott and Turkey Run mercury mines may involve removing all of the existing sediments that contain mercury and replacing them with clean fill and reestablishing vegetation (work on the wetlands would likely be after remediation of the Abbott and Turkey Run mines to eliminated the ongoing source of total mercury into the wetlands).

Alternative 3 projects are a continuation and expansion of Alternative 2 projects and are still considered possible, albeit more extensive and expensive. The more infeasible activities would include sediment removal in the canyon and lower Cache Creek where vehicle and equipment access is difficult. Active or passive remediation of geothermal springs may be technically feasible, but if the springs are too remote treatment may not be practical. It may be difficult and expensive to construct and maintain settling basins

downstream of the mercury mines. If the mines and portions of streambeds that contain mercury are properly remediated, there may not be a requirement to build sediment basins. The sediment basins would be necessary if resources are not available or if liability issues prevent mine remediation.

5.12 Recommended Implementation Alternative

Regional Water Board staff recommends Implementation Alternative 2 for adoption into the Basin Plan. Alternative 2 provides a thorough cleanup plan to reduce methylmercury and total mercury loads that provides the best balance between cost and time to reduce fish tissue concentrations. Alternative 2 is expected to reduce methylmercury loads in Cache Creek by 70 g/year and total mercury loads by possibly 20 kg/year when fully implemented. Alternative 3 includes the baseline remediation and cleanup projects of Alternative 2 and additional source reduction projects designed to reduce mercury loads more quickly but would be more costly.

Alternative 1 (No Action) will not result in the attainment of proposed water quality objectives. The mines would continue to discharge mercury, erosion of mercury hot spots would continue unabated, and sediments containing would continue to release methylmercury into the aquatic environment. The settling basin would continue to trap mercury, but as it fills there are no plans for sediment removal. As noted above, sediment with elevated levels of mercury could continue to erode from the Cache Creek canyon for another 400-500 years.

Under Alternative 2, it will likely take several decades to see a significant change in mercury levels in fish and possibly several hundred years until objectives are attained. This time is expected, given the complexity of mercury cycling in the ecosystem, the presence of naturally occurring mercury in the watershed, the difficulty in reducing sediment concentrations in parts of the Cache Creek canyon that are inaccessible, and the level of effort and money to reduce loads on a watershed wide scale. Alternative 3 will decrease loads of total mercury more quickly, but, because of the quantity of mercury remaining in the Cache Creek canyon, fish tissue concentrations may reach the objectives only slightly sooner.

As part of any implementation plan alternative, the Regional Water Board will review the progress toward meeting the water quality objectives for fish tissue. If new science or remediation strategies evolve, the Regional Water Board will consider updating the Basin Plan amendments for Cache Creek.

Table 5.6.Estimated Costs of Potential Remediation Activities to Reduce Mercury in the Cache Creek Watershed

Remediation Site	Description of Activity	Unit	Estimated Cost (a, b)
No action	Limited amounts of the sediments containing mercury is expected to be buried passively under cleaner sediment entering the watershed		$ 0 for mercury control activities (public outreach and monitoring expenses would still occur; see below)
Abbott and Turkey Run Mines	Mine waste controls (options range from surface water controls and waste consolidation to waste excavation and full containment), surface water controls	325,000 cubic yards of waste rock, ore and tailings	$2.6-5.9 million
Rathburn, Rathburn-Petray, and Clyde mines	Surface water controls, waste consolidation and containment, sediment excavation	120,000 cubic yards of waste rock and tailings	$610,000-3.3 million
Petray North and South mines	Erosion control, excavate sediment	12,000 cubic yards of waste rock	$430,000-720,000
Central, Cherry Hill, Empire, Manzanita, and West End mines	Waste excavation and containment, surface water erosion controls, sediment excavation, streambed restoration	35,000 cubic yards of waste rock and tailings	$870,000- 1.4 million
Elgin Mine	Waste excavation and containment, surface water erosion controls	4,000 cubic yards of waste rock	$620,000
Wide-Awake Mine	Erosion control, waste consolidation, excavate creek sediment, restore stream channels	39,000 cubic yards of waste rock and tailings. 1.25 acres of tailings	$1 million
Stream Restoration Sulphur Creek	Floodplain and stream bank regrading, stabilization, and revegetation. Stream channel stabilization. Flashboard dams to trap sediment, water treatment by aeration, chemical precipitation	0.4 miles	$1.9 million $13 million
Geothermal Springs in Sulphur Creek Mining District, including in-stream springs, Blanck Spring, Elgin Spring, and Turkey Run Spring	Divert springs for water treatment by chemical precipitation	0.2 cfs	$940,000-4.5 million
Remediation of wetlands downstream of Abbott and Turkey Run mercury mines	Remove sediments containing mercury, add clean fill, revegetate	3.5 acres	575,000
Remediation of mine wastes downstream of mercury mines	Grade and revegetate stream banks, excavate sediments containing mercury, stabilize stream channel, revegetate floodplain	0.4 miles	$ 2 million
Remediation of sediments which contain mercury at Harley Gulch delta (confluence with Cache Creek)	Erosion control, stream bank stabilization, sediment removal or relocation	Est. 1.5 acres, 16,000 cy	$950,000

Stream Restoration Sediment Stabilization or Removal at selected sites in Bear and Cache Creeks	Stabilize sediment from eroding or remove to reduce surficial sediment mercury concentrations	Up to 5.6 million cy	$0.5-120 million
Sediment Retention Basins Reduce sediment containing mine wastes transported from tributaries containing mercury mines.	Construct small settling basins to capture sediments with high mercury concentrations transported during storms. Estimated costs include periodic removal of sediment.		$20 million estimate
Cache Creek Watershed Erosion Control	Continue to implement best management practices for erosion control; continue enforcement of ordinances that control erosion. Control grazing, off-road vehicle use and other activities that reduce protective vegetation and result in increased erosion. High effort includes adoption of waste discharge requirements for control of erosion and nutrients that contribute to mercury and methylmercury loads.		Low effort $500,000 (alt 2) to high effort $2-4 million (alt 3)
Anderson Marsh Modifications	Manage water in marsh to reduce inputs to Clear Lake or remediate marsh to reduce methylmercury production		unknown
Public Outreach and Education	Counties and USBLM posting consumption advisories near campgrounds and at access points to Cache and Bear Creek. Counties also providing fish consumption information to local consumers.	Signs, posters Public outreach activities	$10,000 – 20,000
Additional sampling for methylmercury in Anderson Marsh Cache Creek, and Bear Creek to refine methylmercury source analysis and mercury in Bear Creek to verify mine loads.	Sample collection and analyses of water and or sediment for 1-2 years	800-1680 samples	$80,000 – 190,000

(a) Present worth costs. Sources: Tetra Tech, 2004; USGS, 2003;CVRWQCB remediation project at Penn Mine; guidance documents for development of Regional Toxic Hot Spot Cleanup Plans (SWRCB, 1998);

6 MONITORING

Chapter 5 of the Basin Plan describes the methods and programs that the Regional Water Board uses to acquire water quality information. Acquisition of data is a basic need of a water quality control program and is required by the Clean Water Act and the Porter-Cologne Water Quality Control Act. .

A monitoring plan is also an essential element of the Cache Creek watershed mercury reduction strategy. The goal of monitoring is to measure whether mercury loads have been reduced and to track progress in achieving the water quality objectives. Monitoring in the Cache Creek watershed will include fish tissue, water and sediment sampling. Portions of the monitoring program will be site specific (e.g., fish tissue monitoring is only applicable in watersheds that have fish and mine site monitoring will focus on mercury sediment concentrations). Regional Water Board staff will coordinate preparation of detailed monitoring and control plans and obtaining resources to conduct monitoring of sediment, water and fish to assess progress.

Section 2 (Proposed Amendments to the Basin Plan) of this report contains the proposed modifications to Basin Plan Chapter 5 (Surveillance and Monitoring). Section 6 discusses the monitoring program in detail. Section 6.1 contains guidance for fish tissue monitoring for Cache Creek, Bear Creek, and Harley Gulch. Section 6.2 contains guidance for water monitoring within the Cache Creek watershed. The goals of this monitoring are to refine the estimates of methylmercury and total mercury loads from the tributaries and locate any relatively significant sources methylmercury in creek beds and wetlands. Section 6.3 provides information on sediment monitoring in streambed and banks, including the Cache Creek settling basin. This section also provides baseline details for collecting sediment and soil data to characterize mine site cleanup levels.

6.1 Fish Tissue Monitoring

For all fish tissue monitoring discussed below, analysis for total mercury is an appropriate and economical option rather than analysis for methylmercury. Methylmercury comprises 85-100% of the total mercury measured in fish from the Cache Creek watershed (Schwarzbach *et al.*, 2001; Slotton *et al.*, 2004). Total mercury may be analyzed and reported without adjustment instead of methylmercury in fish samples, in order to reduce analytical costs.

To determine compliance with water quality objectives, mercury levels must be measured in fish of the species and sizes frequently consumed by humans and wildlife. The Cache and Bear Creek objectives were developed assuming that humans and large, piscivorous wildlife species (bald eagle, osprey, and river otter) would likely consume fish in the size range of 150-500 mm total length. To facilitate monitoring, a more narrow size range was selected that, based on existing concentrations, has an average concentration equivalent to that of the larger range. For compliance monitoring, TL3 and TL4 fish should span the range of 250-350 mm total length.

The proposed objectives for Cache and Bear Creeks are averages of concentrations in large TL3 and TL4 fish. Monitoring of these large fish can be effectively done once per year on a five to ten year interval. Because adult fish integrate methylmercury levels over a lifetime and changes in mercury loads in Cache

Creek are expected to occur slowly, more frequent sampling of sport fish is not necessary. Once the average concentrations approach the water quality objectives, sampling may be conducted the subsequent two years to verify compliance. The following additional conditions are proposed to determine compliance with the proposed Cache Creek water quality objectives:

- The species proposed for compliance monitoring are
    - TL3: green sunfish, bluegill, rainbow trout (North Fork Cache Creek), and/or Sacramento sucker; and
    - TL4: Sacramento pikeminnow, largemouth bass, smallmouth bass, and/or channel catfish.
- The average concentrations in TL3 and TL4 sport fish are equivalent to the proposed TL3 and TL4 objectives each year for three consecutive years.
- Sample size for determining compliance should be determined using statistical methods approved by the Executive Officer of the Regional Water Board. An appropriate reference is the USEPA's Guidance for Assessing Chemical Contaminant Data for Use in Fish Consumption Advisories (1995b). Staff proposes that the average concentrations should be calculated from at least ten samples from individual fish of each trophic level.
- The sample sets should include at least two species from each trophic level (i.e., bass and Sacramento pikeminnow, for TL4) collected at each target compliance point or stream section. One species is acceptable if two are not available. For example, only pikeminnow have been caught for monitoring in North Fork.
- The proposed compliance sections for Cache Creek are: within the creek between Clear Lake Dam and confluence with North Fork, within North Fork, Cache Creek between Rumsey and the Capay Dam, and Cache Creek between Capay Dam and the Settling Basin Outflow. Compliance sections for Bear Creek are: Bear Creek within Bear Valley and Bear Creek downstream of Sulphur Creek. These compliance sections can be changed upon receipt of updated information about methylmercury production sites and/or distribution of fish populations.

The proposed Harley Gulch objective will be attained when the average concentrations in resident fish (Hardhead, California roach or other small species, TL2/3) are equivalent to the objective for three consecutive years. Because the population sizes in Harley Gulch are small, care must be taken not to decimate them by sampling excessively. Average concentrations should be calculated from at least five samples. These samples may be from individual fish or composites. In Harley Gulch, small fish should also be sampled after control actions are performed as part of tracking the effectiveness of the controls.

Because of the widespread distribution of mercury within Cache and Bear Creeks, Regional Board staff expects that cleanup and subsequent reduction in methylmercury concentrations in fish will take decades. Through periodic monitoring of the species listed above, staff will know when fish tissue levels approach the proposed objectives.

Fish tissue sampling may also be required to evaluate the impact of a particular project. For this purpose, young, TL2 and TL3 fish that remain in a relatively defined home territory should be monitored. Young fish are desired because their methylmercury uptake is largely the result of recent exposure. Therefore, young fish will more quickly reflect changes in mercury bioavailability than will larger or older fish, which integrate mercury uptake across years and large spatial areas. Young California roach, speckled dace, red shiner and inland silversides are species that are recommended for Cache Creek monitoring. A

baseline for levels of methylmercury in these species is fairly well established. Juvenile fish should be sampled regularly after control actions are implemented to track progress.

6.2 Water Monitoring

Water quality monitoring in the Cache Creek watershed is necessary for refining source load estimates, identifying unknown sources, validating the linkage analysis, evaluating the effectiveness of remediation projects, and determining compliance with downstream TMDL allocations (e.g., future load allocations for the Delta mercury TMDL). Recommended monitoring parameters include methylmercury, total mercury, and total suspended solids (TSS), and stream flow. Resources permitting, the Regional Water Board will continue sampling in the watershed for a period of time to further evaluate methylmercury production and refine source estimates. Water quality monitoring will be required for remediations of mine sites and other projects regulated by permits to address mercury. The following descriptions are intended to guide permit writers and further researcher in the watershed.

Levels of methylmercury, total mercury and TSS can be used to indicate whether loads have diminished. Water sampling in major tributaries must include high flow events for mercury and total suspended solids. More frequent monitoring (two to four significant storm events for three consecutive years) is required post remediation to evaluate the effectiveness of cleanup projects and compliance with load allocations.

The proposed Basin Plan amendment contains aqueous implementation goals that correspond to the fish tissue objectives. These goals were derived using water and fish data collected at the sites listed below. The following points or segments are also recommended for future monitoring efforts to track progress toward the aqueous goals. Cache Creek sites are: Cache Creek at Rumsey; Cache Creek between Capay Dam and Road 102; South Fork Cache Creek downstream of the Clear Lake Dam, and North Fork near Highway 20. Sampling points for Harley Gulch are Harley Gulch west branch at Highway 20 (mine sites), west branch upstream of confluence of east and west branches, and east branch upstream of the confluence. Sampling points for Bear Creek are Bear Creek at Bear Valley Road, Bear Creek downstream of mine-associated tributaries, Bear Creek at Highway 20, and Bear Creek at Cache Creek.

The compliance point for Sulphur Creek is Sulphur Creek at the USGS gauge (Near confluence with Bear Creek).

6.3 Sediment Monitoring

Sediment monitoring is required for both assessing watersheds with elevated mercury in soils and evaluating compliance with mine cleanup goals and other remediation projects. A majority of the mercury load in Cache Creek is the existing bed load. Sediment monitoring will be used to evaluate mercury loading from major erosional and depositional areas in the watershed. Post project sediment monitoring will be used to evaluate the effectiveness of bank stabilization and sediment removal projects. Regional Board staff will coordinate participation among landowners in monitoring and continue its own monitoring to identify areas in which mercury concentrations exceed 0.4 mg/kg, dry weight in fine-grained sediment and soil.

Existing sediment data should be evaluated to determine if there is an adequate baseline of information. Regional Board staff has been conducting more detailed sediment surveys in Cache and Bear Creeks to better identify the primary areas where sediment concentrations are elevated and methylmercury is being synthesized. The results of this study will be used to further refine source loads and possible areas to concentrate remediation projects.

Sediments within the creeks should be collected at the mouths of tributaries and at multiple intervals upstream within the tributaries. Sampling sites should be located at secondary stream inputs, significant changes in land use patterns, geothermal springs or other features that might influence erosion rates or concentrations of mercury in the soil. To enable comparisons to be made between sites, sediment samples should be sieved and only the fine sediments (silt/clay fraction, suggested filter size 63 micron) analyzed for mercury.

6.3.1 Mine Site Remediation

The remedial goal for the mines in the Sulphur Creek mining district is based on natural, background levels of mercury in the Sulphur Creek watershed. A preliminary cleanup goal for mercury in soil transported off of the mine areas is 3 mg/kg. The mineralized zones at each mine site vary in terms of range of concentrations and soil types. Local background samples collected by from mine sites vary from a few mg/kg to greater than 100 mg/kg mercury, suggesting that the extent of the zone and minimum concentrations in the mineralized zones are not known. Therefore staff recommends that the cleanup goal for each mine site be refined as the mine owners develop site-specific remediation plans.

The first step in the development of a cleanup plan for each mine will be to map soil mercury concentrations in detail. From a soil concentration map and analysis of erosion potential, estimates of loads from the local background soil would be made for each mine site. Background mercury samples should be collected from non-mined areas and from non-mined areas within the mineralized zone. If the mine has erosion or mercury loading from areas that are within the mineralized zone, the owners should propose a method and sampling plan to best estimate non-anthropogenic background levels. The cleanup goals for the mine sites apply to fine-grained sediment collected in runoff and from the streambeds below the mine sites.

The Executive Officer will approve mine cleanup goals and remediation plans. Sampling frequency and locations will be determined on a site-specific basis and will be included in the proposed cleanup plans.

As an interim tool to determine the effectiveness of mine site remediation, mine owners could propose to frequently monitor Hg/TSS. As noted in the Sulphur Creek TMDL report, the Hg/TSS ratio varies based on the source of mercury. The data show that the initial runoff is associated with a sharp peak in the Hg/TSS ratio that likely represents mobilization of geothermal precipitates. The Hg/TSS ratio then declines to a fairly consistent level throughout the storm. The bulk of suspended sediment transported during high flow likely comes from mercury mine waste and stream banks containing mercury. As these sources are controlled, Regional Board staff expects that the Hg/TSS ratio collected in the latter part of a storm will be significantly lower than existing conditions.

6.4 Special Studies

Recent Regional Board unpublished data suggest that Anderson Marsh, (at the outlet of Clear Lake) may contribute a significant portion of the methylmercury load passing through the Cache Creek dam (Appendix C). Regional Board staff intends to continue monitoring water flow and methylmercury concentrations in Anderson Marsh in 2005.

Regional Board staff also plans additional monitoring in Bear Creek upstream of Sulphur Creek. In the methylmercury source analysis for Bear Creek, Regional Board staff concluded that Sulphur Creek contributes slightly less than half of the methylmercury load in Bear Creek. Concentrations of methylmercury in fish from Bear Creek are exceptionally high, relative to concentrations in fish elsewhere in the Cache Creek watershed. Starting in June 2004, staff has measured aqueous methylmercury at multiple sites in Bear Creek, including upstream and downstream of ephemeral tributaries that potentially drain the Rathburn and Petray mine areas. Staff intends to continue sample collection in 2005 to refine the methylmercury mass balance for Bear Creek. Staff is also coordinating with the USBLM to plan evaluation of the contributions from the Bear Creek watershed mine sites.

7 ENVIRONMENTAL CHECKLIST AND DISCUSSION

All Basin Plans and plan amendments are subject to the California Environmental Quality Act (CEQA). The Secretary for Resources has certified the State Board's water quality planning process as meeting the requirements of Section 21080.5 of CEQA. The Basin Planning process is determined to be "functionally equivalent" to CEQA's requirement for preparation of an environmental impact report or negative declaration and initial study. State Board regulations titled "Implementation of the Environmental Quality Act of 1970" describe the environmental documents required for planning actions. These documents include a written report (staff report), an initial draft of the amendment, and an Environmental Checklist Form. The documents must include either alternatives to the activity and mitigation measures to reduce any significant or potentially significant effect that the project may have on the environment or a statement that the project would not have a significant impact on the environment. The staff report and Environmental Checklist must be functionally equivalent to the environmental documents required by CEQA.

The checklist included in this section was prepared in compliance with this requirement and to assist in identifying potential impacts and outlining mitigation measures. Findings of the checklist are discussed in greater detail following the checklist.

I. Project title:
Amendment to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins – Cache Creek and Tributaries Mercury Water Quality Management Plan

II. Lead agency name and address:
Central Valley Regional Water Quality Control Board
11020 Sun Center Drive #200
Rancho Cordova, CA 95670-6114

III. Contact persons and phone number:
Patrick Morris (916) 464-4621

IV. Project location:
Cache Creek (Lake and Yolo Counties)
Bear Creek (Colusa County)
Sulphur Creek (Colusa County)
Harley Gulch (Lake County)

V. Project sponsor's name and address:
Central Valley Regional Water Quality Control Board
11020 Sun Center Drive #200
Rancho Cordova, CA 95670-6114

VI. General plan designation:
Not applicable

VII. Zoning:
Not Applicable

VIII. Description of project: (Describe the whole action involved, including but not limited to later phases of the project, and any secondary support or off-site features necessary for its implementation. Attach additional sheets if necessary.)

The Central Valley Regional Water Quality Control Board proposes to amend the Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins. The purpose of the amendment is to include commercial and sportfishing as a beneficial use, to establish site-specific water quality objectives for mercury, and to implement a total maximum daily load water management strategy for mercury in the Cache Creek Watershed. The Basin Plan amendment will include an implementation plan to reduce mercury loading into the Cache Creek Watershed. For additional information, refer to the (1) *Amendment to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Mercury in the Cache Creek Watershed Staff Report*, (2) *Cache Creek, Bear Creek, and Harley Gulch TMDL for Mercury Staff Report* and the (3) *Sulphur Creek TMDL for Mercury Staff Report.*

IX. Surrounding land uses and setting: Briefly describe the project's surroundings:
The region affected by this amendment is the Cache Creek watershed, including the watersheds of Bear Creek, Sulphur Creek, and Harley Gulch. Land uses within these watersheds include residential, commercial, agricultural, light industry, grazing and open space. The region has both public and private lands. For additional information, refer to the (1) *Amendment to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Mercury in the Cache Creek Watershed Staff Report*, (2) *Cache Creek, Bear Creek, and Harley Gulch TMDL for Mercury Staff Report* and the (3) *Sulphur Creek TMDL for Mercury Staff Report.*

X. Other public agencies whose approval is required (e.g., permits, financing approval, or participation agreement.)
The State Water Resources Control Board, the Office of Administrative Law, and the U.S. Environmental Protection Agency must approve amendments to the Basin Plan.

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a "Potentially Significant Impact" as indicated by the checklist on the following pages.

	Aesthetics		Agriculture Resources		Air Quality
	Biological Resources		Cultural Resources		Geology /Soils
	Hazards & Hazardous Materials		Hydrology / Water Quality		Land Use / Planning
	Mineral Resources		Noise		Population / Housing
	Public Services		Recreation		Transportation/Traffic
	Utilities / Service Systems		Mandatory Findings of Significance		

7.1 Determination

(To be completed by the Lead Agency)
On the basis of this initial evaluation:

X	I find that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.
	I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.
	I find that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.
	I find that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.
	I find that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.

Signature Date

Jerrold A. Bruns, Environmental Program Manager
Printed Name

7.2 Evaluation of Environmental Impacts

1) A brief explanation is required for all answers except "No Impact" answers that are adequately supported by the information sources a lead agency cites in the parentheses following each question. A "No Impact" answer is adequately supported if the referenced information sources show that the impact simply does not apply to projects like the one involved (e.g., the project falls outside a fault rupture zone). A "No Impact" answer should be explained where it is based on project-specific factors as well as general standards (e.g., the project will not expose sensitive receptors to pollutants, based on a project-specific screening analysis).

2) All answers must take account of the whole action involved, including off-site as well as on-site, cumulative as well as project-level, indirect as well as direct, and construction as well as operational impacts.

3) Once the lead agency has determined that a particular physical impact may occur, then the checklist answers must indicate whether the impact is potentially significant, less than significant with mitigation, or less than significant. "Potentially Significant Impact" is appropriate if there is substantial evidence that an effect may be significant. If there are one or more "Potentially Significant Impact" entries when the determination is made, an EIR is required.

4) "Negative Declaration: Less Than Significant With Mitigation Incorporated" applies where the incorporation of mitigation measures has reduced an effect from "Potentially Significant Impact" to a "Less Than Significant Impact." The lead agency must describe the mitigation measures, and briefly explain how they reduce the effect to a less than significant level (mitigation measures from Section XVII, "Earlier Analyses," may be cross-referenced).

5) Earlier analyses may be used where, pursuant to the tiering, program Environmental Impact Report (EIR), or other California Environmental Quality Act (CEQA) process, an effect has been adequately analyzed in an earlier EIR or negative declaration. Section 15063(c)(3)(D). In this case, a brief discussion should identify the following:
   a) Earlier Analysis Used. Identify and state where they are available for review.
   b) Impacts Adequately Addressed. Identify which effects from the above checklist were within the scope of and adequately analyzed in an earlier document pursuant to applicable legal standards, and state whether such effects were addressed by mitigation measures based on the earlier analysis.
   c) Mitigation Measures. For effects that are "Less than Significant with Mitigation Measures Incorporated," describe the mitigation measures that were incorporated or refined from the earlier document and the extent to which they address site-specific conditions for the project.

6) Lead agencies are encouraged to incorporate into the checklist references to information sources for potential impacts (e.g., general plans, zoning ordinances). Reference to a previously prepared or outside document should, where appropriate, include a reference to the page or pages where the statement is substantiated.

7) Supporting Information Sources: A source list should be attached, and other sources used or individuals contacted should be cited in the discussion.

8) This is only a suggested form, and lead agencies are free to use different formats; however, lead agencies should normally address the questions from this checklist that are relevant to a project's environmental effects in whatever format is selected.

9) The explanation of each issue should identify:
   a) the significance criteria or threshold, if any, used to evaluate each question; and
   b) the mitigation measure identified, if any, to reduce the impact to less than significance

7.3 Issues and Discussion

	Potentially Significant Impact	**Less Than Significant with Mitigation Incorporation**	**Less Than Significant Impact**	**No Impact**
I. AESTHETICS -- Would the project:				
a) Have a substantial adverse effect on a scenic vista?				X
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?				X
c) Substantially degrade the existing visual character or quality of the site and its surroundings?				X
d) Create a new source of substantial light or glare that would adversely affect day or nighttime views in the area?				X

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
II. AGRICULTURE RESOURCES: In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Dept. of Conservation as an optional model to use in assessing impacts on agriculture and farmland. Would the project:				
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?				X
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?				X
c) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use?				X
III. AIR QUALITY -- Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. Would the project:				
a) Conflict with or obstruct implementation of the applicable air quality plan?				X
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?				X

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions, which exceed quantitative thresholds for ozone precursors)?				X
d) Expose sensitive receptors to substantial pollutant concentrations?				X
e) Create objectionable odors affecting a substantial number of people?				X
IV. BIOLOGICAL RESOURCES – Would the project:				
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?			X	
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, and regulations or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?			X	
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?				X
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?				X

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?				X
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional or state habitat conservation plan?				X
V. CULTURAL RESOURCES -- Would the project:				
a) Cause a substantial adverse change in the significance of a historical resource as defined in 15064.5?				X
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to 15064.5?				X
c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?				X
d) Disturb any human remains, including those interred outside of formal cemeteries?				X
VI. GEOLOGY AND SOILS -- Would the project:				
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.				X
ii) Strong seismic ground shaking?				X

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
iii) Seismic-related ground failure, including liquefaction?				X
iv) Landslides?				X
b) Result in substantial soil erosion or the loss of topsoil?				X
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?				X
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?				X
e) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?				X
VII. HAZARDS AND HAZARDOUS MATERIALS Would the project:				
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?				X
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?				X
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?				X

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?				X
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?				X
f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?				X
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?				X
h) Expose people or structures to a significant risk of loss, injury, or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?				X
VIII. HYDROLOGY AND WATER QUALITY -- Would the project:				
a) Violate any water quality standards or waste discharge requirements?			X	
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?				X

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?				X
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?				X
e) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?				X
f) Otherwise substantially degrade water quality?				X
g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?				X
h) Place within a 100-year flood hazard area structures that would impede or redirect flood flows?				X
i) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?				X
j) Inundation by seiche, tsunami, or mudflow?				X
IX. LAND USE AND PLANNING - Would the project:				
a) Physically divide an established community?				X

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?				X
c) Conflict with any applicable habitat conservation plan or natural community conservation plan?				X
X. MINERAL RESOURCES -- Would the project:				
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?				X
b) Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?				X
XI. NOISE Would the project result in:				
a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?				X
b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?				X
c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?				X
d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?				X

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?				X
f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?				X
XII. POPULATION AND HOUSING -- Would the project:				
a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?				X
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?				X
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?				X
XIII. PUBLIC SERVICES				
a) Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:				X
Fire protection?				X

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
Police protection?				X
Schools?				X
Parks?				X
Other public facilities?				X
XIV. RECREATION --				
a) Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?				X
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities that might have an adverse physical effect on the environment?				X
XV. TRANSPORTATION/TRAFFIC -- Would the project:				
a) Cause an increase in traffic that is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections)?				X
b) Exceed, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways?				X
c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?				X

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?				X
e) Result in inadequate emergency access?				X
f) Result in inadequate parking capacity?				X
g) Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?				X
XVI. UTILITIES AND SERVICE SYSTEMS Would the project:				
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?				X
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?				X
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?				X
d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?				X
e) Result in a determination by the wastewater treatment provider that serves or may serve the project that it has adequate capacity to serve the projects projected demand in addition to the providers existing commitments?				X

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
f) Be served by a landfill with sufficient permitted capacity to accommodate the projects solid waste disposal needs?				X
g) Comply with federal, state, and local statutes and regulations related to solid waste?				X
XVII. MANDATORY FINDINGS OF SIGNIFICANCE --				
a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?				X
b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?			X	
c) Does the project have environmental effects that will cause substantial adverse effects on human beings, either directly or indirectly?				X

Discussion of Environmental Impacts

The following is a discussion of possible environmental impact of the proposed Basin Plan amendment. The evaluation is based on the alternatives described in the staff report.

I. Aesthetics

The proposed project establishes water quality objectives for mercury in fish tissue and implements a water quality management strategy for mercury for the Cache Creek Watershed (Cache Creek, Bear Creek, Sulphur Creek, and Harley Gulch). Establishment of water quality objectives will have no direct impact on the aesthetics of the Cache Creek Watershed area. The proposed addition of the commercial and sport fishing(COMM) beneficial use for Cache Creek and Bear Creek will have no impact on aesthetics. While the proposed project itself will not cause a change in aesthetics, responsible parties complying with mercury load reductions may alter the aesthetics depending on their respective projects. For example, the implementation plan requires a reduction in mercury loading from the owners of the inactive mercury mines in Harley Gulch and along Sulphur Creek. The mine owners may perform remediation activities that alter the aesthetics of the abandoned mines. Projects to reduce erosion may in mercury contaminated watersheds may also alter the landscape. Project proponents will conduct a separate environmental analysis prior to initiating remediation projects.

II. Agriculture Resources

The proposed Basin Plan amendment and implementation of a mercury water quality management plan itself will not prescribe changes to agricultural resources. The proposed addition of the COMM beneficial use for Cache and Bear Creeks will have no impact on agricultural resources. It is currently unknown if local agricultural practices contribute to erosion of soils with elevated mercury concentrations. If a land owner or land management agency determines that grazing or other agricultural practices cause significant erosion of soils containing elevated mercury concentrations, the use of management practices to reduce erosion from agricultural activities may be needed to reach the load reduction goals.

III. Air Quality

The proposed Basin Plan amendment and mercury water quality management plan will have no adverse impacts on air quality. The long-term goal of this project is to reduce mercury loading to the local environment, including water and air. Covering of mine waste piles will likely reduce mercury emissions to the atmosphere. The net benefit should be an improvement in air quality with respect to airborne mercury. The proposed addition of the COMM beneficial use for Cache and Bear Creeks will have no impact on air quality.

The water quality management implementation plan will require remediation of mercury mine sites. Remediation activities may involve construction and large earth moving equipment. There may be short-term, localized increases in air pollutants due to particulates and emissions generated from construction equipment. In addition, there may be dust created if mine waste materials are loaded onto trucks, transported, and disposed either on or off site. It is expected that mine remediation will be conducted under state and county air quality control guidelines to

implement dust control measures. Project proponents will conduct a separate environmental analysis to evaluate air quality prior to initiating remediation projects.

IV. Biological Resources

The proposed Basin Plan amendment and water quality management implementation plan for mercury will not adversely impact biological resources. The goal of the water quality management implementation plan is to reduce the overall loading of methylmercury and total mercury to the Cache Creek watershed, which should result in a benefit to biological resources. The amendment is designed to reduce mercury in fish and thus biological resources that consume fish will be beneficially impacted by the amendment. The TMDL report found that it is necessary to reduce the mercury concentration in trophic levels 3 and 4 fish tissue to protect wildlife species consuming fish in the Cache Creek watershed. Reduction of methylmercury in fish tissue will benefit species that are potentially at risk due to mercury contamination, including bald eagle and osprey. Through the implementation plan, the loads of mercury from various sources will be reduced. Any construction or other activities planned to reduce mercury that affect wildlife habitats will be evaluated for environmental impacts to biological resources prior to initiation.

The U.S. Fish and Wildlife Service (USFWS) has reviewed and provided comments on the targets proposed in the TMDL report. One alternative evaluated in the staff report is a water quality objective to protect wildlife. The methylmercury objectives for this alternative are 0.12 and 0.23 mg/kg (wet weight) for trophic level (TL) 3 and TL4 fish, respectively. USFWS recommends reductions in TL3 and TL4 to these methylmercury levels, and the corresponding reduction in TL2 fish concentrations, to be protective of sensitive species of wildlife, including bald eagle and osprey.

Activities conducted in response to the proposed implementation plan may have short-term effects on species of special status or on riparian or other sensitive natural communities. Disturbances may occur depending on the magnitude of remediation and the method selected to reduce the mercury levels in the watershed. If mine sites and creek sediments containing elevated concentrations of mercury are remediated, it is likely that these activities would occur over a relatively small area and within a relatively short time period. Project proponents must identify any impacts from implementing their plan and identify any mitigation measures that are needed.

The proposed addition of the commercial and sport fishing (COMM) beneficial use will not impact biological resources. Sport fishing exists in Cache and Bear Creeks. The addition of this beneficial use designation will not conflict with existing local policies or ordinances.

V. Cultural Resources

The Basin Plan amendment and the water quality management implementation plan for mercury will not directly affect cultural resources. The proposed addition of the COMM beneficial use for Cache and Bear Creeks will have no impact on cultural resources. Any implementation activities to reduce mercury loading that involve land disturbance will undergo environmental review (under CEQA or the National Environmental Policy Act (NEPA)) and will be evaluated on an individual basis as needed. The implementation plan requires remediation of mercury sources that may involve disturbance and removal of mine structures and wastes, and may remove geologic features that were a result of mining activities. Designation of the Cache Creek canyon

as a Wilderness study area, and/or the proximity of candidate locations to traditional cultural sites would require project proponents to comply with additional state and federal requirements.

VI. Geology and Soils

The proposed Basin Plan amendment and the water quality management implementation plan for mercury addresses water quality issues and will not directly impact local geology and soils. The proposed addition of the COMM beneficial use for Cache and Bear Creeks will have no impact on geology and soils. The proposed implementation plan requires that mercury sources be controlled to reduce mercury loading to the Cache Creek watershed. Some mercury load reduction may be realized through a reduction in erosion of mercury-contaminated soils from areas used for grazing or other agricultural practices. There is potential that the remediation activities at the inactive mercury mines (e.g., consolidate and cover waste piles) may result in minor soil erosion and the loss of topsoil during construction. Potential mine remediation may involve mine wastes being covered with topsoil and vegetated. The topsoil has the potential to erode if vegetation does not become established and mature before winter and spring rains. Erosion control measures will be necessary.

VII. Hazards and Hazardous Materials

The proposed Basin Plan amendment and the water quality management implementation plan for mercury address water quality issues and will not directly effect the handling or transport of hazards and hazardous materials. The proposed addition of the COMM beneficial use for Cache and Bear Creeks will have no impact on hazards or hazardous materials. The amendment will not regulate hazards or hazardous materials. There are potential physical and chemical hazards at each mine site. During mine remediation activities, wastes containing high concentrations of mercury may be exposed to sensitive receptors. There will be human and environmental exposure to these wastes during the excavation, transport, and disposal of the mine wastes. Remediation projects will need to include measures to protect workers during construction activities. Dust control measures will minimize exposure. After completion of the remediation projects, mine wastes may be covered or removed and long-term human and environmental exposure will be minimized.

VIII. Hydrology and Water Quality

The proposed project amends the Basin Plan to establish water quality objectives (mercury concentrations in fish tissue). Currently, Cache Creek, Bear Creek, Harley Gulch, and Sulphur Creek are is on the federal Clean Water Act 303(d) list of impaired waterbodies due to mercury. The proposed project contains an implementation plan to reduce mercury loading into the Cache Creek watershed, therefore reducing the mercury concentration in fish tissue in Cache and Bear Creeks and Harley Gulch. In the long term, mercury concentrations should be reduced and water quality standards met.

The proposed implementation plan contains a monitoring plan. The monitoring plan will measure whether methylmercury loads have been reduced to meet water quality objectives. Monitoring will include fish tissue, water, and sediment sampling.

To achieve the load reductions described in the implementation plan, it is possible that some projects may involve removal of contaminated sediments from streambeds and banks and

stabilization of erosive areas. This could possibly result in localized, temporary violations of water quality standards. Standards for turbidity, concentrations of mercury, and possibly concentrations of other minerals could be exceeded. The violations are expected to have limited impact on water quality. Project proponents will be required to address water quality issues prior to implementation.

It is possible that implementation of the proposed project may have effects on surface water hydrology. Management practices at mine sites and contaminated stream and bank sediments may involve surface water diversion around contaminated sediments or the construction of detention basins to trap mercury-contaminated sediments. If proponents elect to mitigate discharges from geothermal springs, there could be impacts to surface water hydrology during the construction and operation of flashboard dams for treatment of geothermal water.

The proposed project will not have a direct effect on groundwater supplies or recharge. The proposed project itself will not have a direct effect on surface water drainage patterns, change the course of streams or rivers, cause increased erosion or siltation, or result in flooding. The mercury water quality management implementation plan requests that property owners evaluate and reduce sources of mercury and reduce erosion of mercury contaminated sediment, therefore improving water quality. Mercury mine remediation activities may alter surface water flows if project proponents install structural controls to divert storm water from mine features and waste piles. The implementation plan requires an evaluation and reduction of mercury loads from tributaries and stream sediments. The goal of the tributary work is to reduce the erosion of soils containing elevated concentrations of mercury. Proponents of mine remediation or erosion control projects will evaluate impacts to hydrology and water quality prior to implementing any remediation activities.

The proposed addition of the COMM beneficial use for Cache Creek and Bear Creek will have no impact on hydrology or water quality. Sport fishing is a present use of Cache and Bear Creeks.

IX. Land Use and Planning

The proposed Basin Plan amendment regulates water quality and does not directly effect land use and planning. The proposed addition of the COMM beneficial use for Cache and Bear Creek will have no impact on land use and planning. However, implementation of the amendment will require a reduction of methylmercury loads to the Cache Creek watershed. State, federal and local agencies and landowners will be responsible for identifying and reducing loads from areas that have elevated mercury/TSS ratios and methylmercury production. While it is not known at this time what methods project proponents will use to reduce loads, it may be possible that land uses may be modified to reduce erosion of mercury contaminated sediment. Land uses that might be affected by this project could include agriculture, grazing, road building and maintenance, and construction activities at areas with elevated mercury concentrations. Likely land use modifications could be application of management practices to reduce erosion caused by grazing and reduction of erosion from road and other construction sites.

Wetlands, ponds, reservoirs, and stream bank restoration activities may be planned in the lower Cache Creek watershed. To comply with the Regional Water Board's goal of no net

methylmercury loading from these types of projects, planners will need to assess the potential for the project to produce methylmercury. Regional Water Board staff does not expect that planned land uses would be altered unless methylmercury loading is anticipated to be increased. Regional Water Board staff will work with restoration project planners to minimize methylmercury production from wetlands.

X. Mineral Resources

The proposed project addresses water quality and control of mercury contamination and will not directly impact mineral resources. The proposed addition of the COMM beneficial use for Cache Creek and Bear Creek will have no impact on mineral resources. There are many mercury mines in the Cache Creek region, however, none of the mines is active and there are no known plans for mercury exploration or mercury mining operations.

XI. Noise

The proposed project addresses water quality and control of mercury contamination and will not directly cause an increase in noise levels. The proposed addition of the COMM beneficial use for Cache Creek and Bear Creek will have no impact on noise. Any proposed remediation activities at the mercury mines will generate noise during any construction activities. Increased noise levels will occur during the excavation, transportation, disposal of the mine wastes, and other earth moving activities. The noise impacts would be temporary and would likely only occur during daylight hours during active construction. Proponents of mine remediation or erosion control projects will evaluate noise impacts prior to implementing any remediation activities.

XII. Population and Housing

The proposed Basin Plan amendment and mercury water quality management implementation plan will not directly affect population and housing. The proposed addition of the COMM beneficial use for Cache and Bear Creeks will have no impact on population and housing. It is not anticipated that reduction of methylmercury loads will displace housing or generate population growth.

XIII. Public Services

The proposed Basin Plan amendment and implementation plan for mercury water quality management will not result in physical alteration of government facilities or adverse physical impacts from construction of new government facilities. Other impacts on public services would be less than significant. The proposed addition of the COMM beneficial use for Cache and Bear Creeks will have no impact on public services.

Until beneficial uses are attained in the Cache Creek watershed, the implementation plan requires that the public be informed of safe fish consumption levels of mercury-contaminated fish. The local county public health departments are responsible for protecting human health. The counties will need to work with the California Department of Health Services and OEHHA to help educate the public about fish consumption. Possible public education activities might include posting of permanent signs at public fishing accesses, preparation and distribution of fliers detailing safe exposure levels, and outreach at public events. Resources or funds to offset costs may be available from the California Department of Health Services.

Reduction of methylmercury and mercury loading sources in Cache Creek and its tributaries may require Colusa, Lake, and Yolo Counties and other governmental agencies to provide resources for evaluation and remediation of mercury hotspots and erosional areas within the Cache Creek watershed. It is expected that most of the required reductions will be accomplished through control of erosion. Erosion control may be a goal of the local counties and watershed groups to address other water quality concerns in addition to mercury.

XIV. Recreation

The proposed Basin Plan amendment and the water quality management implementation plan for mercury will not directly affect recreational activities. There are no known recreational facilities that would be adversely affected by mercury reduction activities. A major benefit from the project would be increased recreational fishing and consumption of sport fish from Cache Creek if the fish had lower mercury concentrations. Lower fish tissue mercury concentrations would allow anglers to keep and consume more locally caught fish.

There is currently a draft fish consumption advisory for Cache and Bear Creeks warning consumers to limit the quantity of fish consumed. Publicity regarding the fish consumption advisory may have negatively impact tourism and fishing in the area. It is expected that reducing mercury in fish will improve public perception of Cache Creek as a recreation site.

The proposed addition of the COMM beneficial use will not have an impact on recreation. Sport fishing is a past and present use of Cache Creek.

XV. Transportation/Traffic

The proposed Basin Plan amendment and implementation plan will not directly affect transportation facilities. The proposed addition of the COMM beneficial use will have no impact on transportation or traffic. Remediation activities at the mines may generate truck traffic during construction phases. Traffic impacts during remediation would be temporary and localized either onsite (for relocating waste rock) or on highways and access roads to the site (for bringing construction equipment and materials).

XVI. Utilities and Service Systems

The proposed Basin Plan amendment and mercury water quality management implementation plan will not directly affect utility and service systems. The proposed addition of the COMM beneficial use for Cache and Bear Creeks will have no impact on utilities or services systems. The proposed Basin Plan amendment and implementation plan will have no impact on existing wastewater treatment systems or result in the construction of new facilities. Construction activities may result in the construction of storm water diversion structures and retention ponds. It is possible that storm water retention basins may be built to collect mercury-contaminated sediment.

XVII. Mandatory Findings of Significance

The proposed Basin Plan amendment and implementation plan provide regulatory guidance for methylmercury reduction in the environment. The amendment does not prescribe the means or methods for the various sources to reduce their respective methylmercury loads to the Cache Creek watershed. The local, State, and federal agencies and respective landowners will make the

decisions to determine methods of compliance. Likely implementation activities are described in Section 5 of this report. The environmental analysis did not find any direct significant impacts from the proposed project that would cause degradation of the environment or cause adverse effects on human beings. The environmental analysis also concludes that there would be no indirect, significant adverse impacts resulting from the proposed Basin Plan amendment and implementation plan.

Adoption of the Basin Plan amendment and implementation plan will not by itself have a physical effect on the environment. However, actions taken by other agencies to comply with the proposed implementation plan may effect the environment. Those agencies will be required to develop and adhere to their respective environmental documents under CEQA, NEPA, and state and local guidelines.

7.4 De Minimus Finding

The Regional Water Board staff, after consideration of the evidence, recommends that the Regional Water Board find that the proposed project has no potential for adverse effect, either individually or cumulatively, on wildlife or the environment.

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